Research Note 85-35

POTENTIAL PREDICTORS OF BATTALION TASK FORCE PERFORMANCE EFFECTIVENESS AT THE NATIONAL TRAINING CENTER

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Battalion effectiveness is the focus of four groups of studies/data bases reviewed and reanalyzed to determine their potential for predicting and understanding battalion effectiveness. Effectiveness at the National Training Center was adopted as a common criterion and components for a conceptual definition of effectiveness were proposed. Results of the reviews and reanalyses indicate that 17 variables from the previous studies/data bases are supported as potential predictors of effectiveness at the NTC. These are NCOs', junior officers' and

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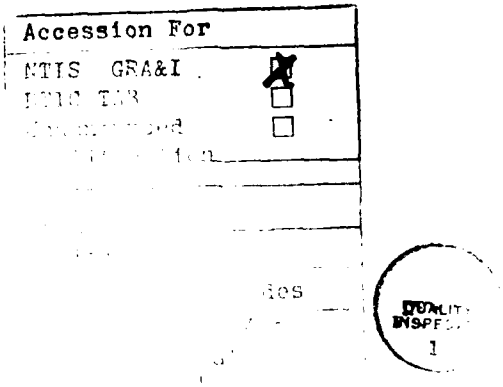
brigade commanders' judgements of effectiveness, ARTEP, AGI, equipment readiness, physical condition, training/cross training, and eight information processing variables.

Once these variables have been validated as predictors of performance at the NTC they can be integrated into a battery for use by the unit as a diagnostic aid prior to training for the NTC.



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LIST OF ACRONYMS

AGI	Annual Ceneral Inspection
AMORE	Analysis of Military Organizational Effectiveness
ANOVA	Analysis of Variance
ARI	Army Research Institute for the Behavioral and Social Sciences
ARTEP	Army Training and Evaluation Program
AS	Associator
AWOL	Absent without Leave
BCATF	Battalion Combined Arms Task Force
BPP	Battalion Performance Prediction
CAB	Combined Arms Battalion
CATTS	Combined Arms Tactical Training Simulation
CEOI	Communications-Electronic Operation Instructions
CN	Channel and Net
CO	Commanding Officer
CPX	Command Post Exercises
DC	Decider
DCSPER	Deputy Chief of Staff for Personnel
DE	Decoder
EN	Encoder
FTX	Field Training Exercises
FORGE	Factors in Military Organizational Effectiveness
HHC	Headquarters and Headquarters Company
HumRRO	Human Resources Research Organization
JTOC	Jun[illegible]actical Operations Center
LSPA	Liv[illegible]g Systems Process Analysis
ME	Memory
MET	Mission Essential Team
MOSC	Military Occupational Specialty Code
N	Number of Data Points
NBC	Nuclear, Biological, Chemical
NCO	Non-Commissioned Officer
NTC	National Training Center
OT	Output Transducer
OPSEC	Operations Security
REDCON	Readiness Condition
SAIC	Science Applications International Corporation
TOC	Tactical Operations Center
TOE	Table of Organization and Equipment
TRADOC	Training and Doctrine Command
USR	Unit Status Report

EXECUTIVE SUMMARY

This is the final report of the battalion performance prediction (BPP) project whose impetus was derived from the Army's Systems Science Conference of December 7-9, 1983. The conference was held in response to a request from Ms. Amoretta Hoeber, Principal Deputy Assistant Secretary of the Army for Research, Development and Acquisition, to assess the utility of applying systems science constructs to Army problems. One recommendation of the conference was that basic research should be undertaken to determine the relationship between systems science and battalion effectiveness.

For several years the Army Research Institute for the Behavioral and Social Sciences (ARI) has been engaged in both systems science research and research on battalion effectiveness. A major aspect of ARI's system science research was the Cary et al. (1982) study which examined the unit effectiveness of 35 battalions in terms of Living Systems Theory. Three other groups of studies constitute a large portion of ARI's research on battalion effectiveness: ARI investigations of command climate variables; several studies of command group behavior; and a host of analyses focused on organizational effectiveness. These four major lines of research can be viewed as converging at a common focal point: battalion effectiveness measurement.

Prior to establishing a common focus for these research efforts, no attempt had been made to critique their methodologies and integrate those findings which prove robust enough to survive a critique. For example, the Organizational Effectiveness studies analyzed many potential influences on battalion effectiveness; however, the total of these studies has neither been critiqued nor integrated relative to some common unit effectiveness criterion. Furthermore, neither the data from the Cary et al. study nor the Command Climate Data Base had ever been fully analyzed. Finally, the Command Group Behavior Research had never been reviewed as a potential source for predictors of battalion effectiveness. As a result of the compartmentalized nature of these four different groups of studies, no attempt had been made to interrelate their findings in order to produce a definitive understanding of ARI's ability to predict battalion effectiveness. Therefore, the purpose of this BPP project was to enhance ARI's ability to understand and predict battalion effectiveness by further investigation of its Command

Climate, Command Group Behavior, Organizational Effectiveness, and System Science studies for potentially valid and reliable indicators of battalion performance effectiveness. In other words, the effort was designed to "look across" all four categories of research, extract potentially valid predictors of battalion performance effectiveness, and "shut the door" on lines of research that have proven fruitless.

One of the problems which made interrelating the four categories of research difficult was that few of the studies in the four different groups had defined battalion effectiveness similarly. Also, in many of the studies, readiness and capability had been mistaken for effectiveness. To remedy this and to supply some standard against which to evaluate previous research, performance of tactical missions at the National Training Center (NTC) was chosen as a general common criterion of effectiveness.

In order to assist ARI in developing an understanding of and an ability to predict effectiveness at the NTC, Science Applications International Corporation (SAIC) undertook five highly interrelated tasks. The first of these was the identification of potential components that could be used in a conceptual definition of effectiveness at the NTC, and a specification of the types of data required to assess effectiveness in terms of these components. Tasks two through five each entailed an in-depth review and reanalysis of one of the four groups of studies (Command Climate, Command Group Behaviors, Organizational Effectiveness, and Cary et al.). Finally, the predictors of effectiveness which survived critical review were integrated into a rudimentary prediction approach for future validation.

Components for a Conceptual Definition of Effectiveness

In order to be able to identify the types of data which would be required to assess effectiveness at the NTC, and to have a more specific common criterion for interrelating the previous studies and identifying predictors of effectiveness, components which could be used to form a specific definition of a criterion of effectiveness were identified. The approach to identifying potential components of a conceptual definition of effectiveness was the classical one of identifying the performance requirements of the battalion task forces which perform at the NTC. The performance requirements were identified by the Army during detailed mission/task

analyses in support of the Army Training and Evaluation Program (ARTEP) 71-2 (U.S. Army Headquarters, 1981). These mission/task analyses resulted in the identification of six general missions which are required for all the tactical missions of battalion task forces. These six general missions, identified in ARTEP 71-2, were suggested as sources for a conceptual definition of effectiveness. The six missions are:

1. Plan and Control Operations
2. Maintain Operations Security
3. Perform Tactical Intelligence Functions
4. Conduct NBC Defense Operations
5. Defend against Air Attack
6. Conduct Sustaining Operations

Based on the ARTEP, SAIC further defined the six general missions in terms of the tasks which comprise them and the types of data required to assess their accomplishment. Finally, the required types of data were compared to the types of data collected at the NTC and the differences were noted. Most of the types of data required to assess effectiveness are already collected at the NTC for some of the tactical missions. The required types of data may have to be collected for all the tactical missions at the NTC if effectiveness is to be adequately assessed. It is also necessary to establish via empirical research, the interrelationships of these criterion components in order to develop an effectiveness assessment model against which predictors might be regressed.

Command Climate Studies

ARI's Command Climate Data Base is composed of organizational climate data and some effectiveness data from a total of 71 battalions which were surveyed over the course of approximately 26 months. Six studies of the Command Climate Data Base were critically reviewed for this project, and some of the Command Climate Data were reanalyzed.

In-depth reviews of the six studies, especially as they relate to the prediction of effectiveness at the NTC, are reported in Appendix D. In an attempt to address some of the questions that the six studies left unanswered, new analyses of some of the data were conducted. The results of

the new analyses and those conducted during the previous studies indicate that seven of the Command Climate variables may be potentially valid predictors of effectiveness at tne NTC. The seven are listed and described briefly below.

- o NCOs', Junior Officers', and Brigade Commanders' Judgements of Effectiveness. These are ratings of the effectiveness of their units.

- o ARTEP. This is the percentage of areas rated "satisfactory" on a unit's last ARTEP report.

- o AGI. This is the percentage of areas rated "satisfactory" on a unit's last Annual General Inspection.

- o Equipment Readiness. This is the percentage of a unit's equipment on-hand that is rated ready.

- o AWOL. This is the percentage of those in a unit who are absent from duty without leave.

NCOs', junior officers', and brigade commanders' judgements of effectiveness were rated by senior officers as the best indicators of battalion effectiveness (Kerner-Hoeg and O'Mara, 1981), and they were all highly intercorrelated (O'Mara, 1981). The ARTEP and AGI also were rated as being some of the top indicators of battalion effectiveness (Kerner-Hoeg and O'Mara, 1981). Equipment readiness is highly correlated with both ARTEP and AGI (O'Mara, 1981) and with junior officers' judgements of effectiveness as analyses of this project revealed. AWOL was highly correlated with both junior officers' and NCOs' judgements of effectiveness, and it was also ranked by senior officers as one of the best indicators of effectiveness (O'Mara, 1981).

Command Group Behavior Studies

The Command Group Behavior studies reviewed during this project were a three year study of battalion performance in the Combined Arms Tactical Training Simulation (CATTS), the FORGE I (Factors in Military

Organizational Effectiveness) study and the Cardinal Point II study. The latter two were based on battalion staff performance in the PEGASUS simulation. All three studies used actual or ad-hoc command groups of battalions whose performances were rated and classified by independent observers. In addition, SAIC reviewed other research efforts suggested by the COTR and found them irrelevant to the present investigation. All three relevant studies focused primarily on the relationships between information processing behaviors of the command groups and their effectiveness as indicated by ratings of observers and/or battle outcome scores originated by the simulations.

The results of the study based on CATTS were not robust and revealed several problems with the reliability of the data. Nevertheless, they indicated that the effective transmission of information is critically related to effectiveness. Command groups spent much more time gathering and transmitting information than in making decisions and if enough information is gathered, required decisions flow almost automatically from the information. Also important to effective command group performance is the comprehensive, accurate, timely and complete dissemination of information.

The results of the FORGE I study are similar to those of the CATTS study. For example, the FORGE study also found that command groups must actively seek out information and that their effective performance is dependent upon insuring that information is widely disseminated to all appropriate personnel. In addition, the results indicated that the processes of successful seeking and disseminating of information are more important than having "good decisionmaking." This finding is congruent with the CATTS study's conclusion that if enough information is collected, appropriate decisions almost "make themselves."

The results of the Cardinal Point II study are questionable because of several methodological problems with the reliability of the observers. However, they did support the notion that information processing was more integral to effectiveness than were decisionmaking, stabilizing or coping types of cognitive processes. In fact, they showed that acquiring, processing, transmitting and testing the validity of information were all highly intercorrelated and strongly related to effectiveness.

Critiquing all three studies and integrating the surviving conclusions led to the selection of the following seven variables as potential predictors of effectiveness at the NTC.

- o Information Seeking. The time (or proportion of communications) spent actively gathering information.
- o Communication Efficiency. The ability to transmit required information in brief and explicit terms.
- o Communication Accuracy. The ability to transmit information without errors or omissions.
- o Completed Communications. The proportion of communications that actually arrive at their intended destination.
- o Communication Timeliness. The proportions of communications received in time to achieve their intended purpose.
- o Information Dissemination. The extent to which information is distributed to all personnel who may be able to use it.
- o Decisionmaking Quality. The ability of command staff to rapidly make appropriate command decisions.

Organizational Effectiveness Studies

These studies were all based on a methodology entitled the Analysis of Military Organizational Effectiveness (AMORE). This is a computer assisted methodology which was basically designed to measure a unit's capability to internally form functional teams of personnel and equipment. The methodology is typically used to assess a unit's capability to "bounce back" after the unit has been partially depleted of its personnel and material as a result of combat. The most critical variables the methodology considers as influences on a unit's capability to build teams are the degree to which members of a unit are deemed able to do each others' jobs (substitutability) and the degree to which a unit's resources are depleted. For

identifying predictors of effectiveness at the NTC, the construct of substitutability and its components were the critical focus of the review.

Ten studies were reviewed in order to identify potential predictors of effectiveness at the NTC. The relationship between substitutability and a unit's capability to form teams was determined from a regression analysis of the results of these studies. The regression analysis showed that the correlation between substitutability and a unit's capability to form teams is .59. The results of the ten studies also indicated that four components of substitutability were supported as potential predictors of effectiveness at the NTC. These potential predictors are listed and defined below.

- o Training/Cross Training. This is the degree to which enlisted personnel have skills training in their own and other specialties.
- o Cohesiveness/Morale. This is the degree to which a unit has high esprit de corps.
- o Physical Condition. This is the average degree of physical conditioning exhibited by all the members of a battalion.
- o Equipment Maintenance. This is the degree to which a battalion maintains its equipment.

Cary et al. Study

The Cary et al. study is one of ARI's few systems science studies of battalions. Based on living systems theory (LST), it focused on determining the relationships between many LST based processes theoretically required of all living systems, and measures of the effectiveness of battalions in garrison. Thirty five battalions were assessed in terms of LST processes and scores on these variables were correlated with a measure of battalion effectiveness. Many different measures of nine processes were found to be significantly related to the measure of battalion effectiveness. Multiple regression analyses revealed that 96 percent of the variance of the

effectiveness measure could be accounted for by three variables. It is these three which were considered as potential predictors of effectiveness:

- o Memory Timeliness. The timeliness of storing or retrieving information within the battalion.
- o Internal Transducer Accuracy. The accuracy of internal reporting about battalion activities.
- o Associator Timeliness. The timeliness of recommendations made for procedural changes.

However, the prospects of these variables being predictors of effectiveness at the NTC are qualified by the fact that these variables were shown to be potential predictors of in-garrison effectiveness, not effectiveness in situations similar to combat.

Conclusions

It was concluded, based on the relative validities and generalizabilities of the four groups of studies, that the suggested predictors derived from the Command Group Behavior Studies were supported more strongly as predictors of effectiveness at the NTC than were the variables derived from the other groups of studies. Those derived from the Organizational Effectiveness and Cary et al. Studies are the least supported as potential predictors.

Finally, it was concluded that two indicators from the Command Climate Data Base (AWOL rates and equipment readiness) were redundant with two variables derived from the Organizational Effectiveness Studies (cohesiveness/morale and equipment maintenance). In addition, two variables from the Cary et al. study (memory timeliness and internal transducer accuracy) were redundant with two derived from the Command Group Behavior Studies (communication timeliness and communication accuracy). The four variables from the Organizational Effectiveness and Cary et al. Studies were dropped leaving 17 suggested predictors of effectiveness at the NTC for future integration and validation. These are shown in Table ES-1.

Table ES-1. POTENTIAL PREDICTORS OF EFFECTIVENESS AT THE NTC

Command Climate	Command Group Behavior
NCOs' Judgements of Effectiveness	Information Seeking
Junior Officers' Judgements of Effectiveness	Communication Efficiency
Brigade Commanders' Judgements of Effectiveness	Communication Accuracy
ARTEP	Completed Communications
AGI	Communication Timeliness
Equipment Readiness	Information Dissemination
AWOL Rates	Decision-making Quality
Organizational Effectiveness	**System Science**
Training/Cross Training	Associator Timeliness
Physical Condition	

The Command Climate variables that call for judgements could be measured by using rating scales while ARTEP and AGI measures can be obtained from units' latest reports of those types. Measures of equipment readiness and AWOL rates can be obtained from Unit Status Reports (USR).

The Command Group Behavior variables will be more difficult to obtain but could be derived from ratings of command post exercises (CPX) or field training exercises (FTX) or the written narratives of these exercises.

The Organizational Effectiveness variables could both be measured from the USR. Training/cross training could be measured from the number of skills qualification tests unit personnel had passed. Physical conditioning could be measured by the percentage of unit personnel having passed their annual physical training test.

The Cary et al. variable of associator timeliness could be measured in garrison by a questionnaire developed in the Cary et al. study.

In summary, this BPP project identified and provided support for several potential components which could be integrated in a conceptual definition of effectiveness at the NTC. However, these predictors will require further development if they are to be used as a valid set of criterion measures. In addition to providing suggestions to support the definition of effectiveness, the types of data not collected at the NTC which would be required to assess "effectiveness" were identified. Four sets of studies/data bases were reviewed in detail relative to the components of effectiveness and 17 variables were identified which may predict effectiveness at the NTC. Nine of the 17 variables are currently and routinely collected by battalions. Before being validated, the group of 17 potential predictors should be augmented from additional sources such as military experts. If validated against criteria of effectiveness at the NTC, these and possibly additional predictors could be used by a battalion in garrison to identify the types of training which would make the battalion more effective at the NTC and in combat.

Section 1
INTRODUCTION

1.1 BACKGROUND

The impetus for this BPP project began with the Army's Systems Science Conference of December 7-9, 1983. The Conference was held in response to a request of Ms. Amoretta Hoeber, Principal Deputy Assistant Secretary of the Army for Research, Development and Acquisition, who asked that the utility of applying systems science constructs to Army problems be assessed. In her opening address to the Conference, Ms. Hoeber asked the participants to focus on six areas, two of which this project addresses: (1) the identification of problem areas in which systems science offers a useful approach to solutions; and (2) the development of a plan which identifies system science related research requirements. As a major conclusion of the conference, the participants agreed that one of the most important areas in which systems science may be useful is in the assessment of unit operations/effectiveness, especially at the battalion level. In fact, the conference recommended that basic research should be undertaken to ascertain the relationship between systems science and battalion effectiveness.

For several years, ARI has been engaged in both systems science oriented research (e.g., Rusco, G. et al., 1979; Whittenburg, J., 1981) and in research on battalion effectiveness (e.g., Carter et al., 1983). One such study by Cary et al. (1982) examined the unit effectiveness of 35 battalions in terms of Living Systems Theory. The Cary et al. study examined several specific issues among which were the relationships between unit effectiveness and information management. Unit effectiveness was measured in terms of command indicators (and other measures) which are often referred to as command climate variables. In attempting to examine the relationships between unit effectiveness and command climate, the study generated an enormous amount of data which had not been examined in the context of other related efforts prior to this project.

Several years ago ARI began a large research effort which also focused on command climate variables as predictors of battalion effectiveness (O'Mara, 1981). The effort examined 71 battalions and generated what

is commonly referred to within ARI as the Command Climate Data Base. Prior to this project, the Command Climate Data Base had not been exhaustively examined. More importantly, the data and relationships found in the Command Climate Data Base had never been compared to, or considered in the light of, the relationships found in the Cary et al. study.

ARI also had sponsored research on battalion effectiveness which focused on the behaviors of command groups. This group of studies includes a rather large study of Command Group Performance in CATTS (Combined Arms Tactical Training Simulation) (Carter et al., 1983). However, as with the previously mentioned studies, the data and conclusions of the Command Group Performance in CATTS study and others of this type had not been fully exploited or related to those of the Cary et al. or Command Climate Studies.

A fourth area of research, partially sponsored by ARI and with a focus similar to those previously mentioned, concerned investigations of organizational effectiveness guided by an analytical approach entitled the Analysis of Military Organizational Effectiveness (AMORE) (cf. Conroy et al., 1984). AMORE has been used to investigate several influences on battalion effectiveness including some of the variables contained in the Command Climate Data Base. However, few, if any, of the organizational effectiveness studies had been related to any of the Command Group Behavior Studies, the Cary et al. study or the Command Climate Data Base.

With its system science research, ARI had already begun, prior to the Systems Science Conference, to undertake the charge established at the Conference (i.e., to ascertain the relationship between systems science and battalion effectiveness). While the Command Climate, Command Group Behavior, and Organizational Effectiveness studies did not take an explicit systems science approach, it was the similarities of the data bases/studies which, in addition to the impetus generated by the System Science Conference, coalesced to form the seed for this BPP project.

1.2 PURPOSE

The four research areas of interest to ARI (described in Section 1.1) all had battalion effectiveness as a focus. Yet few of these studies defined battalion effectiveness similarly. The Command Climate Studies referred to measures of climate, status, etc., as measures of effectiveness. The Cary et al. study used the global ratings made by battalion members together with "performance indicators" (e.g., Unit Status Report results, Skill Qualification Test results) and "command indicators" (e.g., Annual General Inspection results, number of personnel actions) as measures of effectiveness. The Command Group Performance in CATTS study employed both global ratings of performance and casualties as measures of effectiveness. All of the Organizational Effectiveness studies used as measures of effectiveness the degree to which a unit had the personnel and material to form functional teams. Upon careful examination it was found that several of the studies from all four groups made the mistake of equating effectiveness to readiness or capability (Sarkesian, 1980). In addition, because there was no practical way to measure effectiveness, all the measures used in these studies were very far removed from the performance of a unit in combat--a unit's ultimate criterion of effectiveness (Sarkesian, 1980).

With the advent of the Army's National Training Center (NTC) the measurement of genuine effectiveness in combat became a much closer possibility because the NTC is a training facility that simulates combat with very high fidelity. Many of those familiar with the NTC believe that with some qualifications, it is possible to generalize results from the NTC to real combat (Science Applications, Inc., 1982). With such a generalization as a possibility, ARI saw that the adoption of effectiveness in the performance of tactical missions at the NTC as a criterion of battalion effectiveness would supply a single appropriate and unifying criterion to which the variables investigated in the four research areas of interest could be related. The establishment of a common criterion for effectiveness would allow ARI to examine the variables from the four research areas with an eye toward comparison. Thus the development of the components of a conceptual definition for effectiveness at the NTC also became a goal of this project.

With a focus on effectiveness at the NTC, the overall purpose of this BPP project became one of identifying, summarizing and interrelating

information on the prediction of effectiveness at the NTC, as derived from the four sets of studies/data bases (Organizational Effectiveness, Command Climate, Cary et al. and Command Group Behavior). In other words, the goal of this effort was to deduce potentially valid predictors of combat effectiveness from the four research areas and finally "close the door" on those aspects of past research which proved fruitless.

1.3 OBJECTIVES

The general purpose of the project is elaborated in the following objectives: (1) identify components for a conceptual definition of effectiveness at the NTC in order to provide a criterion for identifying potential predictors of effectiveness; and (2) identify potential predictors of battalion effectiveness at the NTC from the Cary et al. study, from the Command Climate Data Base, from the Command Group Behavior Studies, and from the Organizational Effectiveness Studies. The first objective was enlarged to include the identification of the types of data required to assess effectiveness at the NTC. All such data types may not presently be collected at the NTC; although the NTC focuses on training, the types of data collected at the NTC were not determined with a systematic, top down approach such as the Army's Instructional System Design (ISD) process. Also, during NTC development, the determination of the data types presently collected was secondary to the determination of the hardware and instrumentation required at the NTC.

1.4 TASKS

The project objectives were realized by performing five complex and highly interrelated tasks. The first of these tasks was to analyze the NTC environment and the battalion task force missions performed at the NTC in order to identify the components of a conceptual definition of battalion effectiveness at the NTC. The purpose of this was to provide a criterion for identifying predictors of battalion effectiveness. The components that could be used to define effectiveness were then used to identify the types of data required to assess effectiveness and to point out which of the required types of data are actually collected at the NTC. More specifically, the basic tasks of the performance of battalion task forces at the

NTC were identified as were the types of data required to assess effectiveness. The types of data required to assess effectiveness were compared to the types of data collected at the NTC, and the similarities and differences between the two groups were noted.

The second through the fifth tasks each entailed the study and reanalysis of one of the four research areas previously described. These analyses were designed to identify potential predictors of battalion effectiveness at the NTC. However, data on the performance of battalions at the NTC were not available for this project because of the brief duration of the project, the prohibitively difficult logistics of acquiring such data, and the sensitivity of such data. Since predictors of performance at the NTC were to be identified without access to the data of battalions which had performed at the NTC, SAIC's approach to identifying predictors became of necessity analytical; in a sense one of identifying candidates for predictors, or potential predictors. This identification of the potential predictors was based on analyses of the four studies/data bases, analyses and extrapolations from research which relied on criteria similar to effectiveness at the NTC, and some new analyses of the four studies/data bases conducted by SAIC specifically for this Battalion Performance Prediction Study.

The remainder of this report is divided into six sections; the first addresses the NTC, and the next four are each primarily devoted to one of the four research areas of interest to ARI: the Cary et al. study, the Command Climate Data Base, Command Group Behavior Studies, and the Organizational Effectiveness Studies. The last chapter is devoted to a summary and integration of the potentially valid predictors into a conceptual battalion performance prediction system.

Section 2
NTC EFFECTIVENESS AND RELATED DATA

2.1 BACKGROUND

The first objective of this project was to develop components for a single and unifying conceptual criterion of effectiveness which could be used to identify predictors from the four data bases/research areas. This objective was realized by identifying components for a "straw man" conceptual definition of effectiveness for task forces performing at the NTC. The objective was not one of developing a full-blown evaluation system with specific evaluation measures and weights for component parts; it was only to establish the missions/dimensions and possibly major tasks for each tactical mission. However, the objective of developing a conceptual definition of effectiveness is tantamount to developing the beginnings of an evaluation system for battalion task forces performing at the NTC.

While the evaluation components of training systems should specify comprehensive pre- and post-training evaluations and examine performance at a very fine level such as that of the individual task or behavior, evaluations conducted for "performance appraisals" or "reviews" need not take such a fine-grained look at performance. The purpose of performance appraisals is usually more global--not one of providing detailed indications of remedial needs. Thus the identification of components for a conceptual definition of effectiveness at the NTC which could serve as a criterion for predictors did not require the development of an evaluation system having a very fine-grained level of analysis.

In addition to identifying components for a definition of effectiveness, a second NTC related objective of this project was to identify the types of data required to assess effectiveness which are presently collected at the NTC. The types of data required to assess effectiveness which are not collected at the NTC were also to be identified.

The approach to identifying components for a "straw man" definition of effectiveness was the classical one of identifying the required performances and proposing them as components which could be used in a conceptual definition of effectiveness. The required performances resulted

from mission/task analyses. Subsequently, the tasks and the types of data required to evaluate effectiveness were also identified. Then the NTC data base was searched for the types of data already collected at the NTC which are similar to the types identified as required for evaluating effectiveness. Finally, the data required were compared to the data collected and shortfalls were noted.

Attempts at validly and reliably measuring battalion effectiveness began many years ago. Earlier attempts to measure the effectiveness of a battalion occurred in ways and at places far removed both geographically and conceptually from combat. For example, battalions in garrison were measured in terms of the numbers of people and things that were operational. Obviously these are necessary for effective combat performance but they are not sufficient. With the advent of the NTC, the use of "remote" criteria was no longer necessary. The training environment at the NTC was designed to provide the highest possible degree of similarity to real combat. The primary purpose of the NTC is training for the improvement of performance--the task forces perform each tactical combat mission to the best of their ability. Thus, effectiveness at the NTC was chosen as this project's basis for some future criterion of effectiveness.

The NTC is a facility at Ft. Irwin, California where highly realistic, comprehensive and intensified training for battalion task forces is conducted. Task forces are transported to the facility and engage in tactical missions and reviews of their performance. Typically every month two new task forces with their brigade command group arrive at the facility. They engage an opposing force which attempts to mimic anticipated Soviet Army tactics. The opposing force is a battalion size U.S. Army force stationed at Ft. Irwin which is run by U.S. Army personnel assisted by SAIC personnel. Most of the task forces which train at Ft. Irwin are the combined arms type with either mechanized infantry or tank. However, some other types of forces have trained at the NTC, such as a cavalry squadron.

The task forces select from a variety of tactical missions available to them, those tactical missions most appropriate for their training. Although there is variability among task forces in terms of the tactical missions they select, each of the tactical missions contains elements of electronic warfare, live fire and close air support.

In addition to executing their tactical missions, task forces engage in after-action reviews (AAR) of mission performance. The reviews consist largely of the replay of computer generated representations of the firing and movement of both the opposing force and the task forces in training.

The instrumentation at the NTC provides for the collection of data during the execution of the tactical missions and the processing of these data. Some data are collected at the NTC by in-the-field, observer controllers (OCs) who report their data through the instrumentation system. There is an OC assigned to every unit of platoon size and larger. Data collected by OCs are mostly related to the execution of specific tasks or aspects of submissions. Much of the data are qualitative and judgemental in nature. On the other hand, the data generated by the instrumentation system are fire and movement type data. Most of these data are generated automatically by a radio based multilateration system (for location), laser simulated fires, and laser sensitive receptors for registering "hits."

2.2 APPROACH TO IDENTIFYING COMPONENTS OF EFFECTIVENESS

The method used to identify components for a conceptual definition of battalion task force effectiveness began with the standard first step of determining what is required of the task forces in the performance of their tactical missions. In other words, what they are supposed to do. This was accomplished by relying on a mission/task analysis. The mission/task analysis began with an identification of the missions, goals, and environments which a task force could encounter at the NTC. This analysis revealed that the typical situation and events for most task forces are a two week stay at Ft. Irwin, a desert environment, where each task force engages in approximately 10 tactical missions (e.g., defense in sector; hasty attack). Task forces, in conjunction with their brigade headquarters and the NTC staff, choose the tactical missions in which they will engage. Their choices are made months prior to actually engaging in the exercises. At the inception of the NTC, 12 different tactical missions were planned as possible missions for task forces. The original 12 tactical missions have been increased and changed, and the process of adaptation continues. In addition, many variations of the basic set of tactical missions are now possible. Thus any future definition of battalion effectiveness at the NTC

should be generic enough to define effectiveness for a large variety of possible tactical missions.

Since effectiveness at the NTC should be measured across a wide variety of tactical missions, a mission/task analysis was required for each of them. Fortunately, the U.S. Army has performed mission/task analyses for most of the tactical missions of battalion task forces. The results of those analyses are embodied in an official Army document--Army Training and Evaluation Plan for Mechanized Infantry/Tank Task Force (ARTEP 71-2) (U.S. Army, 1981). The proponent of ARTEP 71-2 is the Commandant of the U.S. Army's Infantry School. Because of the official nature of ARTEP 71-2 and the painstaking work that went into performing the mission/task analyses, ARTEP 71-2 was chosen to serve as the major source of components for a conceptual definition of effectiveness for battalions at the NTC. It was assumed that the missions, "combat-critical tasks", and standards of performance specified for task forces in ARTEP 71-2 contain adequate and accurate requirements for the performance of most tactical missions by battalion task forces at the NTC. In fact, the ARTEP states that it provides the structure for the performance of all task force missions and tasks. Moreover, it provides "standards that permit evaluation of the effectiveness of training...."

The approach taken to identifying components for a definition of effectiveness for the wide variety of the NTC tactical missions was to attempt to develop a single definition or scheme for evaluating effectiveness and have the scheme include fundamental tasks inherent in all 12 NTC tactical missions. This was done because there is considerable overlap amongst the tasks of the 12 tactical missions and having a separate evaluation structure for each tactical mission would reduce reliability and result in too many observations and too much data.

The tasks for all battalion task force tactical missions are also in ARTEP 71-2. The introduction to ARTEP 71-2 states that Section 1 "contains six general missions that are applicable to all or most missions and echelons. Missions in this section are usually conducted throughout all operations...." In other words, the six general missions are really the functions basic to all tactical missions. The six general missions (or functions) were formulated to include all the missions and tasks critical to

the performance of a task force. Thus, it was assumed that the basis for any future criteria of effectiveness is contained in the six general missions. It is the six general missions listed below which are proposed as the sources for components of a conceptual definition of effectiveness for the NTC:

- o Plan and control combat operations
- o Maintain operations security (OPSEC)
- o Perform tactical intelligence functions
- o Conduct NBC defense operations
- o Defend against air attack
- o Conduct sustaining operations

To further specify the components for a criterion of effectiveness for the NTC, the ARTEP's analysis of the six general missions into between seven and seventeen "tasks" (e.g., control direct fire, control fire support) was used. The ARTEP's mission critical tasks were analyzed to determine if they were necessary in the NTC environment, and sufficient for evaluating the performance of task forces at the NTC. The tasks were analyzed by retired field grade military officers with Masters level credentials in ORSA and years of battalion level experience. The officers expert military opinion was augmented by NTC documentation, Field Manuals, and the related work of the Army's Ft. Leavenworth NTC Unit Training Division (UTD), contained in their "NTC Training, Recording and Reporting Plan." The UTD plan contains a critical task listing for combined arms task forces engaged in the defense in sector tactical mission at the NTC. The work performed by the UTD in establishing the critical task list and deriving criteria for use by the OC's represented a significant step forward in the measurement of effectiveness. It is our recommendation that this process be carried out for all missions at the NTC. The analysis of the ARTEP tasks revealed that all were appropriate for consideration as NTC tactical effectiveness measures. In addition, the ARTEP missions and tasks subsume all of the critical tasks in the UTD plan. These conclusions were not surprising since the ARTEP's six missions are general missions and, as the ARTEP states, are "applicable to all or most missions" of the combined arms task force.

Rather than adopt the ARTEP tasks verbatim as a further specification of the components of effectiveness at the NTC, the tasks were rephrased

in the form of questions that could be asked to evaluate effectiveness at the NTC. In addition, the focuses of a few of the ARTEP tasks were combined into single questions.

Following the identification of appropriate tasks and their translation into questions, the types of data required to answer the questions were determined. The types of data required also were derived primarily from the ARTEP 71-2. The ARTEP lists conditions and standards for each task, and it was these that were used to help derive the required types of data.

2.3 RESULTS

The analysis of the ARTEP tasks resulted in the identification of components which could be included in a definition of effectiveness. The components are presented in Appendix A (in Volume II) and consist of the six general missions discussed in the previous section and the 19 major tasks required to perform the general missions. The 19 tasks are all important and complex. One such task raises the question, "Was the unit able to maintain orientation?" This entails an in-depth knowledge of navigation and location. Many of the 19 tasks break the general mission down into either planning or execution tasks. They are probably the most detailed level at which a unit's effectiveness at the NTC should be assessed. Appendix A (in Volume II) presents the suggested components along with the corresponding types of data presently collected at the NTC (the process used to identify the corresponding types of data is explained in the next paragraph).

Following the identification of the types of data required to assess effectiveness at the NTC, the structure of the NTC Data Base was examined to determine which of the required types of data are presently collected at the NTC. Four sources were tapped to understand the data architecture and its elements:

- SAIC requirements design specifications for the NTC software
- SAIC requirements design specifications for an NTC research data base system

- o Ft. Leavenworth UTD's NTC training, recording and reporting plan

- o SAIC expertise derived from developing the NTC's core instrumentation system.

Based on an in depth review of these sources, hundreds of NTC data elements were identified. Almost all of the types of data are recorded in realtime and a much smaller subset is copied in to files for composing after-action reviews. Data are produced primarily by two types of sources--instrumentation and OCs. The data produced by instrumentation is recorded automatically and is related primarily to location, movements, weapon firings, weapon "hits", and casualties. All of these are recorded by type of unit and time. The data produced by the OCs is transmitted by them to the NTC headquarters where it is recorded on tape either in-stream or in a preformatted fashion. Most of the data collected by the OCs are either "Elements of Information" (EIs) or "Observable Events" (OEs). These are ratings or "yes/no" type notations. For example:

EI

Were all key leaders at OPORD briefings?
(0 = not applicable; 1 = yes; 2 = no)

Did commander have a plan for limited visibility conditions?
(0 = not applicable; 1 = yes; 2 = no)

Were FRAGOs clear and concise? (rate from 1-9)

OE

Did commander plan for local counter attacks? (rate from 1-9)

Were disengagements coordinated? (rate from 1-9)

Were back briefs used? (0 = not applicable; 1 = yes; 2 = no)

EIs and OEs were developed for the NTC by the Ft. Leavenworth UTD whose efforts provided a substantial foundation for this objective of the project. (See Appendix B in Volume II for the OEs and EIs abbreviated in Appendix A.)

The structure and types of data collected at the NTC were reviewed and compared to the types of data required to assess effectiveness. The results of these comparisons are located in Appendix A. As can be seen in Appendix A, most of the required data are already being collected at the NTC. In fact, there are some appropriate types of data for all of the 19 major tasks and for 34 of the 48 required types of data.

2.4 DISCUSSION AND CONCLUSIONS

2.4.1 Components for a "Straw Man" Definition of Effectiveness

As pointed out by Sarkesian (1980) there are many definitions of battalion effectiveness and many of the definitions emphasize that a valid measure of effectiveness should contain many elements. The six general missions and 19 major tasks proposed as potential components are based on a thorough and painstaking mission/task analysis performed by the Army; thus they comprise most of the appropriate components for a definition of effectiveness for battalion task forces performing at the NTC. However, in order to have a well defined criterion of effectiveness for evaluating task forces and/or validating predictors, the components proposed previously (and/or others) will have to be combined into a specific definition of effectiveness, i.e. some metric which purports to measure effectiveness.

The components proposed in this chapter have not been weighted and thus the ones that should have large weights may appear to be unreasonably de-emphasized. For example, it might be valid to give both mission accomplishment and percentage of force remaining after an exercise (or casualties) a combined weight equal to 80% of the sum of all weights for all components of the definition. Such a weighting is not as disproportionate as it may seem at first glance, for traditionally military historians have viewed effectiveness in terms of: (1) whether the assigned mission was accomplished, and (2) whether the unit "lived to fight another day." In the expanded AirLand Battle 2000 (U.S. Army Training and Doctrine Command, 1982) and in the Preface to the Army Training and Evaluation Plan (ARTEP) 71-2, it

is very clear that to win the next war the U.S. Army must avoid high combat losses in order to defeat an enemy who outnumbers U.S. forces and whose weapons equal U.S. weapons in sophistication. AirLand Battle 2000 states that:

> The highly lethal battlefield of the future and the overwhelming force potential of our enemies argues for avoidance of all out attrition type warfare. Victory must be sought through maneuver, advantageous positioning of forces, use of deception, psychological efforts to erode the enemy's will, and exposure of minimum friendly forces to destructive weapons effects.

In a similar fashion, many current military analysts view effectiveness as contingent on a unit's potential to accomplish assigned missions and whether the unit "lived to fight another day." In an ARI study at Ft. Leavenworth, Thomas and Cocklin (1983) found support for this view in that several military analysts they studied, who were also retired field grade military officers, had perceptions of unit effectiveness which overwhelmingly empnasized the components of mission accomplishment and living to fight another day (casualties).

The components proposed in this chapter specify only the major dimensions of effectiveness, their subtasks and the appropriate types of data required to assess effectiveness. The development of the components into an evaluation system would require, in addition to an appropriate weighting system, the development of protocols, procedures, evaluator training, and, of course, the development of specific measures such as rating scales or checklists.

2.4.2 NTC Data for Assessing Effectiveness

The types of data required to assess the effectiveness of battalions at the NTC were compared to the types of data presently collected at the NTC. As Appendix A (in Volume II) shows, most of the data required to assess effectiveness are already being collected at the NTC. There are some types of data presently being collected which could be used in the assessment of all 19 of the major tasks listed in Appendix A. Of these 19 tasks,

there are only five for which there are insufficient data being collected at the NTC to adequately assess the performance of the task. Also, there are some types of data presently being collected which are similar to 34 of the 48 required types of data specified in Appendix B. Of these 34 types of data, there are nine for which there are insufficient data being collected.

However, it may not be necessary to collect all of the required types of data. If the missing types of data addressed effectiveness components relegated to a very low weight in an algorithm for combining all the elements of effectiveness, it might be feasible to overlook such data since its low weight would not significantly influence the assessment of effectiveness.

Several aspects of the NTC environment could influence the validity or the practicality of obtaining the data required to assess effectiveness. One of these aspects is that the EIs and observable events are collected for only the defense in sector mission. For none of the other tactical missions are the OCs required to report EIs and observable events. Thus at present, these classes of data are not available for most exercises at the NTC. In addition, no check has been made of the reliability of the OCs' data. Since the OCs have received very little training on how to make the observations required for EIs and observable events, the reliability of their observations is questionable.

Another aspect of the NTC which may effect the data is the considerable variability in the responses of the OPFOR to each of the existing task forces. Such variability could be statistically controlled in a study of the validity of potential predictors of effectiveness; however, statistical control would require the study to use a very large number of task forces.

One other aspect of the NTC environment which could affect the practicality of using some of the types of data is the fact that much data is collected on-line and stored "in-stream." Many required data types are not automatically copied to summary files but remain stored "in-stream." These include types such as the separation distance of major pieces of equipment.

2.4.3 Summary

The objectives of this activity within the BPP project were to: (1) identify components which could be used in a "straw man" conceptual definition of effectiveness for battalion task forces at the NTC, and (2) to identify the types of data required to assess effectiveness which are not collected at the NTC. The components of effectiveness identified were the six basic missions and the 19 major tasks specified in ARTEP 71-2 as those required for, or common to, all tactical missions for battalion task forces. The general missions and tasks were derived from a detailed mission/task analysis. As a further development, the types of data required to assess effectiveness were identified. The types of data required to assess effectiveness were compared to the types of data collected at the NTC and differences were noted.

Section 3
COMMAND CLIMATE DATA

3.1 BACKGROUND

The command climate related objective of this project was to identify predictors of effectiveness at the NTC from the Command Climate Data Base. This was accomplished by analyzing all available published research on the Command Climate Data, consulting at length with the original authors, and by conducting several new analyzes of the data. Apparently this is the first effort to describe and integrate all available publications on the Command Climate Data.

Command climate is more universally known as organizational climate, embodied in those behavioral processes of an organization reflecting the organization's members' values, attitudes and beliefs. Organizational climate has been described as having four major dimensions: (1) individual autonomy, (2) degree of structure, (3) reward orientation, and (4) maintenance (Campbell, Dunnette, Lauler, and Weick, 1970). Typical components of these dimensions which have been studied include independence, orientation to rules, clarity of objectives and methods, orientation to profit or sales, and managerial support of employees.

Organizational climate is often regarded as being similar to, or the same as, organizational structure. However, organizational structure is usually more formalized than organizational climate. Structure is often embodied in an organization's literature, policies, practices, organization charts, and training. Payne and Pugh (1976) make a useful and interesting distinction between an organization's structure and its climate by suggesting that structure is analogous to terrain or such features as rivers, valleys and mountains, whereas climate is analogous to temperature, humidity, etc. (climate).

Organizational climate research has included numerous studies attempting to define/refine and measure the construct. Several reliable and respected measures of organizational climate have been produced such as Litwin and Stringer's Organizational Climate Questionnaire (1968). Organizational climate research on the relationship of climate to other variables

has focused primarily on three areas: organizational structure (cf. Phesey and Payne, 1979), job-satisfaction (cf. Schneider and Hall, 1973), and personality (cf. Pervin, 1967). Only a very small group of studies has focused on the relationship between climate and organizational performance effectiveness (cf. Andrews, 1967).

In the U.S. Army, organizational climate has traditionally been referred to as command climate. It is usually considered to be reflected by "command indicators" or "traditional indicators" (Kerner-Hoeg and O'Mara, 1981). These indicators include variables such as disciplinary actions, crime rates, and reenlistment rates. Also, these variables or composites of them have often been used as generic indicators of unit readiness, effectiveness (Sorley, 1980), and morale (Motowidlo et al., 1976). The distinction among these terms is relevant to this project, the purpose of which is to identify potential predictors of effectiveness at the NTC. It is suggested that effectiveness at the NTC should be based on performance, and both readiness and morale are antecedents and influences on such performance.

The Command Climate Data Base is actually several data bases all composed of data collected by ARI during a multi-year research effort. The data bases differ by the degree to which the data were aggregated across either time or organizational unit. In order to review and analyze the Command Climate Data, SAIC requested from the government, through the contracting officer's technical representative, a copy of the data and all reports of research involving the data. SAIC received a magnetic tape copy of one very aggregated data base without documentation identifying the variables of the data base, and a report by Bowers and Davenport (1984). Subsequently, on several occasions, SAIC debriefed the two principal architects of the data collection effort, neither of whom presently work for ARI. They provided five reports of different analyses which they had performed on the data, some descriptions of the procedures used in the five reports and verbal recall of the identities of some of the variables on the magnetic tape. Since the data were collected over four years ago, corporate memory and that of the principals was insufficient to document all of the issues surrounding the data and its analyses.

It is clear that ARI intended the data for several purposes. In general the data were supposed to provide the grist for a wealth of studies addressing organizational or command climate issues and their relationship to readiness or effectiveness. The data collected include types related to either unit readiness or command (organizational) climate.

3.2 APPROACH TO COMMAND CLIMATE DATA COLLECTION

3.2.1 Overview

The data in the Command Climate Data Base were collected by three different means: questionnaires administered to personnel in the units studied (questionnaire data), forms completed by Army unit personnel which contained standard Army measures collected routinely by the units and contained in unit records (record data), and personal interviews conducted by researchers (interview data). It is not SAIC's purpose in this review of the Command Climate Data to recklessly expose flaws in the studies. It is obviously very difficult to perform longitudinal studies in the context of changing organizations like the Army. Rather it was our charge to find out what valid and reliable conclusions could be drawn from the data and to discuss the unsupportable observations that always result from long term investigations like this one.

Data were collected on five occasions over the course of almost three years. For the first four data collections, each separated by six months, interview and questionnaire data were collected about the present condition of the units and the personnel in them. On these same occasions, record data also were collected for the present and previous quarter, except on the first wave when the present and previous four quarters of record data were collected. Table 3-1 coordinates these pairings.

The first wave data were solicited from 59 battalions. At least 15 of these were dropped from the study before wave two and they were replaced by eleven others to make a total of 55 battalions for wave two. Similar events occurred in conjunction with subsequent waves, so that by the end of the study, data had been solicited from a total of 71 battalions. However, data do not exist for all battalions for each wave or quarter. Analyses of the data tape supplied to SAIC reveal that there is record space

for a total of 69 battalions yet there are missing data symbols recorded for all values of all variables for the last 13 battalions. In effect, the tape contains some data on only 56 battalions at most. None of the reports on the data base indicate the rationale used to select battalions.

Table 3-1. DATA COLLECTION EVENTS

WAVE	QUARTER	TYPE OF DATA
	1	Record
	2	Record
	3	Record
	4	Record
1	5	Record Questionnaire Interview
	6	Record
2	7	Record Questionnaire Interview
	8	Record
3	9	Record Questionnaire Interview
	10	Record
4	11	Record Questionnaire Interview
	12	Record
5	13	Record Questionnaire Interview

The next three sections further describe the methods used for collection of the Command Climate Data and are devoted respectively to questionnaire, record, and interview data.

3.2.2 Questionnaire Data

The questionnaire data were collected on four occasions by administering questionnaires with 140 to 163 items. Appendix C (in Volume II) contains a copy of the questionnaire used for wave 4 (Bowers and Davenport, 1984). The questionnaire was changed between waves 2 and 3 and between

waves 3 and 4 so that at least three different versions were used. Twenty-two items were added to the questionnaire between waves 2 and 3. On all occasions it was administered to personnel assembled in large groups.

Kimmel and O'Mara (1981) indicate that all the questionnaire items were taken from a questionnaire designed to measure organizational climate (Taylor and Bowers, 1972). Taylor and Bowers' work relied on a measure of climate developed by Likert (1967).

Bowers and Davenport indicate that questionnaire data was designed to be obtained from a random sample of both officers and enlisted men from each battalion. The subject selection process for waves 3 and 4 (none of the reports describe the process for waves 1 and 2) was intended to produce a sample of twenty E1-E4s, ten NCOs, and five officers from each company, and five battalion level officers from the battalion at-large. The point-of-contact (POC) at each of the military installations involved was responsible for personnel selection. The POCs were asked to select first those individuals whose social security numbers ended with an 8 and then those whose social security numbers ended with a 7.

Desired sample sizes were 40 personnel per company or approximately 200 per battalion. The data given to SAIC do not indicate the number of subjects used. However, Bowers and Davenport indicate that approximately 115 personnel per battalion were surveyed on waves 2 and 4. None of the reports indicate the sample sizes for wave 1.

In addition to difficulties with sample size, the review of the literature revealed that the quality of the questionnaire data is suspect (Bowers and Davenport, 1984). First, neither the reliability nor the validity of the questionnaire was ever investigated. Second, the motivation of the participants must have been very low since they received no incentive for completing the questionnaire, sometimes had to wait hours to receive it, and often had to complete it under very poor conditions. These conditions included poor lighting, the lack of writing surfaces (e.g., on a firing range), and excessive noise. Several indicators support the contention that motivation was low and probably affected data quality. These include reports of laughter and excessive chatter during many of the group administrations. Also, as an example, over 18% of the questionnaires were

excluded from the wave 3 data because they exhibited answer patterns indicative of bogus responses. Such patterns included answering "D" to an important question whose only choices were "A" or "B"; answering four successive A's, then four successive B's, then four C's, etc.; and repetition of ABCDCBA. There were also several indications that most respondents did not believe their data would remain anonymous. Finally, the administration of a second 35 item questionnaire on wave 3 added to the confusion surrounding instructions (Bowers and Davenport, 1984).

Another group of influences on data quality involve the selection of respondents. Prescribed selection procedures were not followed as the distribution of the last digits of the respondents' social security numbers reveals. The distribution was normal yet the selection procedures specified selecting first as many personnel as possible whose numbers ended with 8, then those with 7. Several researchers were told that those selected were either the most available or the most "expendable." Moreover, the selection process resulted in a sample size, on the average, equal to roughly only 50 percent of those desired and only 15-20 percent of the average battalion's population (Bowers and Davenport, 1984).

3.2.3 Data from Unit Records

Data from unit records were collected in five waves by supplying battalions with forms to complete which were supposed to be returned to the researchers. The forms requested company level information which was later aggregated to the battalion level. The forms were designed to obtain data on all command climate and readiness measures typically collected by a company. The measures (and their definitions) are listed in O'Mara (1981) and in Tables 3-2 and 3-3. None of the reports on the Command Climate Data reveal pertinent aspects of the unit record data such as the sample sizes, variances, anomalies, or rules for combining it to the battalion level.

Table 3-2. READINESS MEASURES

OVERALL READINESS	A battalion's overall readiness status as reported in the monthly Unit Status Report.
PERSONNEL READINESS	A battalion's personnel readiness status as reported in the monthly Unit Status Report.
EQUIPMENT ON HAND	An index of the degree to which a battalion possesses all authorized equipment, a reflection of the battalion's supply system.
EQUIPMENT SERVICEABILITY	The maintenance status of a battalion's equipment, a reflection of the battalion's maintenance system.
EQUIPMENT READINESS	The proportion of equipment a battalion actually has on hand that is operational.
ARTEP	The percentage of the missions/tasks rated "satisfactory" during a battalion's most recent field training exercise.
AGI	The percentage of the areas rated "satisfactory" during a battalion's most recent annual general inspection.
WEEKS TO READINESS[a]	The Cdr's estimate of the number of weeks required to bring the unit up to full readiness status.
TRAINING READINESS[a]	A Cdr's subjective estimate of the units' overall training readiness.

[a] These variables were used but not defined in O'Mara (1981).

Table 3-3. COMMAND INDICATORS

ARTICLES 15	The percentage of enlisted personnel administered nonjudicial punishment (e.g., fines, reductions in grade) during a given month.
COURTS MARTIAL	The percentage of enlisted personnel receiving a court martial during a given month.
AWOL	The percentage of enlisted personnel who were involved in unexcused absences during a given month.
DESERTIONS	The percentage of enlisted personnel who deserted during a given month.
FIRST TERM REENLISTMENT	The percentage of a battalion's first-term reenlistment objective that was achieved in a given month.
CAREER REENLISTMENT	The percentage of a battalion's reenlistment objective for career personnel that was achieved in a given month.
CRIMES OF VIOLENCE	The percentage of a battalion's enlisted strength involved in crimes of violence in a given month.
PROPERTY CRIMES	The percentage of a battalion's enlisted strength involved in crimes against property in a given month.
DRUG ARRESTS	The percentage of a battalion's enlisted strength arrested for drug and marijuana violations in a given month.

3.2.4 Interview Data

Interview data are those which were obtained during discussions with battalion, brigade, division, and assistant division commanders. Each interview was conducted in the interviewee's office by a member of the Command Climate research staff. The interviewees were asked nine questions.

1. What is the single biggest problem for you in achieving and maintaining the readiness of your command?

2. How have you coped with this problem?

3. What is the second largest problem in achieving and maintaining the readiness of your command?

4. How have you coped with this problem?

5. What types of indicators do you use to determine whether the criterion (effectiveness) is achieved?

6. Rate the effectiveness of the battalions under you in an eight point scale?

7. Rank order in terms of effectiveness the battalions under you.

8. How accurate would an assessment of a battalion be if it were based on _____ (Ratings of 0-100 were requested for each item on a list of traditional readiness and command indicators).

9. Which five of the following measures of effectiveness provide the most complete picture of a battalion's overall effectiveness (the same list of measures was used as was used in question eight).

The interview data are briefly described in two papers: O'Mara's (1981) paper in which no sample sizes are reported, and Kerner-Hoeg and

O'Mara's paper (1981) in which it is stated that 48 battalion commanders, 28 brigade commanders, and eight general officers (presumably division commanders) were interviewed.

New analyses conducted on the data supplied to SAIC revealed that the data contain single scores (not answers to nine questions) for division commanders of 35 battalions for each wave, three and four single scores for assistant division commanders on 27 and 38 battalions for wave 3 and 4 respectively, and single scores for brigade commanders on 31 and 35 battalions on waves 3 and 4. No battalion commander interview data were identified on the tape version of the data, nor were any other interview data for the division, assistant division or brigade commanders.

The single scores for the various commanders were computed as described in O'Mara (1981). They involved converting the commanders' ratings and rankings for each battalion into standard scores and then these standard scores were "combined into a single battalion effectiveness score for that rater" for each battalion.

The rankings from commanders were obtained on only those battalions within their command and some officers had more battalions under their control than others. This fact caused the range of measurement to vary across battalions. For example, one battalion could have gotten a ranking of "3", meaning third out of five battalions; whereas, another battalion could also have gotten a "3", but been ranked third of three. No indication is given that scores were adjusted to allow for comparability across all battalions measured.

No procedures for selecting the interviewees were described in any of the reports on the data analyses. Presumably, for each of the 71 battalions represented in the data base, the brigade, division, assistant division and battalion commanders of the 71 battalions were to be interviewed. The commanders at all levels who actually did participate in the study were the only personnel of the target group who were probably both willing and able to participate.

As previously mentioned, the Kerner-Hoeg and O'Mara (1981) paper states that 48 battalion commanders were interviewed, yet none of the

battalion commanders' data appear to be on the data tape nor was a principal author of several of the papers on the data able to identify the battalion commanders' data. In addition, while the O'Mara (1981) paper deals with the "personal judgements" (effectiveness ratings) of E1s-E4s, NCOs, junior officers, and brigade, assistant division and division commanders, it does not mention battalion commanders. Moreover, the list of readiness and command indicators supplied to interviewees as stimulus material to be rated and ranked does not contain battalion commanders judgements, but it does contain the judgements of all the other levels of personnel dealt with in the O'Mara (1981) paper (i.e., COs of all levels, NCOs, etc.).

3.2.5 Summary of Data Collection

The questionnaire data are based on a large sample and many interesting questions. However, the procedures used to select both battalions and personnel within battalions are of very dubious reliability. The sample size as a proportion of the size of the battalion should have been larger especially given the apparent motivational levels of the respondents.

By contrast, the unit record data are much more reliable, having no within-battalion selection problem or problem with the motivational level of those supplying the data. However, the quality of the procedures used to select the battalions is circumspect and the percentage of companies within battalion responding is unknown. Nevertheless, these data appear relatively objective, reliable, and plentiful.

The publications based on the interview data provide little clarification as to reliability and validity. No descriptions are given of the procedures used to select commanders, their response rates, or their representativeness. Moreover, the ranking data is of questionable reliability.

3.3 RESULTS

3.3.1 *Previous Analyses of the Command Climate Data*

Available previous research on the Command Climate Data is described in six papers which are reviewed in Appendix D (in Volume II). One of them (Davenport and Bowers, 1984) involves analyses done primarily on all

the types of data derived from the questionnaire. Another (Kimmel and O'Mara, 1981) focused on a few of the types of data derived from the questionnaire. The other four papers concern data derived from either interviews, unit records or both. Five of the six papers were written by persons who were members of ARI during the data collection effort and who also managed the data collection effort. The Davenport and Bowers paper, focusing almost exclusively on the questionnaire data, is the only one of the six written by non-ARI personnel.

Across the six studies of the data, the results and conclusions are sometimes in agreement and sometimes contradictory. Each will be briefly discussed with respect to the identification of predictors of battalion effectiveness at the NTC.

Bowers and Davenport (1984). The more important findings of this study for the prediction of effectiveness at the NTC are that company level effects had the strongest unit-level influences on the questionnaire data. Battalion-level effects were insignificant. However, it should be noted that these effects were on questionnaire data, not hard performance data. In addition, the company level effects accounted for less than one percent of the variance of the questionnaire data. All of these findings or lack of variance accounted for could be related to the authors concerns about the quality of the data.

O'Mara (1981). In determining the interrelatedness of the three types of "effectiveness" measures, O'Mara showed that the command indicators (e.g., Article 15, AWOL rates) and even the USR measures have very low intercorrelations. The personal judgements show degrees of interrelatedness ranging from low to fairly high; the higher correlations are for personal judgements between individuals of similar ranks. Two of the questions the study raised are whether it was advisable to average correlations across waves and what the relationships are between measures in different groups (i.e., between the personal judgements, readiness indicators and command indicators).

Kerner-Hoeg and O'Mara (1981). In assessing the validity of the three types of "effectiveness" measures by obtaining commanders' estimates of the measures' accuracy, the authors found support primarily for the

validity of the AGI, ARTEP, and both junior officers and NCOs estimates of the effectiveness of their battalions. These findings are bolstered by O'Mara's (1981) finding of a high correlation (.55) between the estimates of NCOs and junior officers.

O'Mara, Kerner-Hoeg and Balzar (1982). The most valid conclusion of this study of the temporal dynamics of the three types of "effectiveness" measures is that the variables appear to exhibit different rates of change. The authors also concluded that such a finding again substantiates that the measures are related to different underlying constructs. However, this conclusion is not very strongly supported.

Kimmel and O'Mara (1981). In this study of a potential measure of unit morale, the authors developed a measure that may assess satisfaction with one's unit but the measure does not appear to tap any of the other elements typically thought to comprise morale.

Kerner-Hoeg and O'Mara (1980). In this study of the effects of a change of command, the authors focused on a variable with much apparent potential as a predictor of effectiveness at the NTC. However, the authors concluded that the analyses revealed no effects due to change of command. Other more powerful analyses may yield different results.

3.3.2 Analyses of the Command Climate Data

There are literally hundreds of questions for which the Command Climate Data Base could be analyzed. Many of these questions involve the quality of the data and others involve issues similar to those researched in the six papers reviewed. In order to shed some light on a few of these issues SAIC was provided a tape copy of some of the Command Climate Data (aggregated to the battalion) and information on the identities of some of the variables on the tape. SAIC was asked to perform appropriate new analyses of the data to determine its value and to select robust variables which could be transformed into valid predictors of unit effectiveness.

3.3.2.1 Rationale. Under the constraints of limited resources and time, SAIC conducted some preliminary analyses of the wave 3 and 4 data. Since all of the Command Climate Data could not be analyzed, the data of waves 3

and 4 were chosen because they appeared more complete and more reliable than data from the other waves. The purposes of the preliminary analyses were to determine some of the general characteristics of the data not reported by previous studies. These included the Ns (number of data points) per variable and per correlation, the amount and type of missing data, the distribution of the data by variable including the distributions' means, variances, skewness, kurtosis and probability of having been sampled from a normal distribution. In addition to describing the data, the results of the preliminary analyses would allow for determinations of the feasibility of additional analyses such as correlations, and cluster and factor analyses.

3.3.2.2 Analyses and Results. Analyses were conducted on all of wave 3 and wave 4 interview data, unit record data, and the questionnaire items about unit effectiveness. The other questionnaire data were not analyzed because of their doubtful reliability and validity and because those data were also excluded from all but one of the previous studies of the Command Climate Data.

The first set of analyses conducted was an attempt to determine the general characteristics of the data. Table 3-4 contains most of the descriptive statistics calculated. Column one of the table lists the variables used in most of the reports on the Command Climate Data. Each wave 3 variable is followed by the same variable for wave 4. Column two of the table contains the number of battalions per variable and column three indicates the variance for each variable. Columns four and five contain the skewness and kurtosis per variable and column six contains the probability associated with the W or D statistics used to determine if the sample came from a normal distribution. The average N for the variables is 40 and the sample size ranges from 9 to 55. Most of the variables have moderately sized variances; however, 25 of the 50 variables have W or D statistics whose probabilities are .01 or less. Since all but one of these 25 variables have either skewness or kurtosis greater than 1.0, it appears safe to conclude that those variables do not have normal distributions.

The biggest problem associated with these data is not that many of the variables have non-normal distributions, for most robust statistics are not significantly affected by non-normality. Rather it is that the data are Table 3-4.

Table 3-4. DESCRIPTIVE STATISTICS FOR "EFFECTIVENESS" MEASURES

VARIABLE	N	$\bar{X}$	SD	SKEW	KUR	P
Overall Readiness	43	2.2365	0.7282	0.8160	0.5630	.01
Overall Readiness	49	2.6878	0.7743	-0.3695	-0.0845	.01
Personnel Readiness	34	2.0394	0.6073	0.0686	-0.2920	.04
Personnel Readiness	49	2.5306	0.9231	-0.0652	-0.9834	.01
Equip. on Hand	43	1.6433	1.0673	1.3387	0.1726	.01
Equip. on Hand	49	1.2445	0.5878	2.5555	5.8099	.01
Equip. Serviceability	44	1.3336	0.4779	1.5988	2.0890	.01
Equip. Serviceability	49	1.4965	0.6747	1.3419	1.1194	.01
Training Readiness	44	1.2882	0.8814	0.2507	0.5731	.01
Training Readiness	49	1.6737	0.6791	0.4812	-1.0819	.01
Weeks to Readiness	43	2.1861	0.8814	0.2501	0.5731	.01
Weeks to Readiness	49	2.8245	1.1755	0.0451	-0.4581	.04
Equip. Readiness	18	93.3278	3.8210	-0.8409	-0.3380	.04
Equip. Readiness	20	90.6150	6.0685	-1.033	0.3531	.02
Expeditions Discharge	38	0.4318	0.3914	0.6473	-0.5529	.01
Expeditions Discharge	38	0.4600	0.3961	1.3577	2.7514	.01
Adverse Discharge	37	0.7384	0.4929	0.3806	-0.9078	.04
Adverse Discharge	38	1.2563	3.7505	6.0469	37.0032	.01
Article 15	40	7.4890	3.4217	-0.0021	-0.6387	.59
Article 15	40	7.3085	3.7114	0.6304	0.8796	.29
Courts-Martial	44	0.3220	0.3435	1.5524	0.1180	.01
Courts-Martial	41	0.4995	0.6555	1.8682	3.3189	.01

Table 3-4. DESCRIPTIVE STATISTICS FOR "EFFECTIVENESS" MEASURES
(Continued)

VARIABLE	N	$\bar{X}$	SD	SKEW	KUR	P
AWOL	43	1.7874	1.2012	0.8244	0.4966	.03
AWOL	42	2.1879	1.8481	1.6290	3.2019	.01
Desertions	43	0.5167	0.4066	0.4113	-0.8567	.01
Desertions	42	0.6429	0.5355	0.8436	-0.1492	.01
First-Term Reenlistment	40	116.5391	68.6197	1.7529	3.7678	.01
First-Term Reenlistment	41	107.2616	64.7230	1.8191	4.8724	.01
Career Reenlistment	40	97.8733	50.7171	0.4589	0.4177	.33
Career Reenlistment	41	131.8531	71.5053	1.8787	4.8813	.01
Crimes of Violence	44	0.4152	0.7140	3.5220	15.5428	.01
Crimes of Violence	42	0.3186	0.5029	2.2214	5.2446	.01
Crimes Against Property	45	1.2731	1.1804	1.2900	3.1150	.01
Crimes Against Property	42	1.2160	1.1533	0.952	0.1275	.01
Drug Arrests	46	1.4330	1.1212	1.3897	2.5187	.01
Drug Arrests	42	1.1267	0.8085	1.0777	0.6397	.01
ARTEP	9	91.9967	9.2142	-0.8293	-0.8773	.06
ARTEP	12	89.6333	13.6106	-0.9812	-0.5666	.01
AGI	12	89.2992	11.2539	-1.5899	2.0908	.01
AGI	19	84.6295	14.6771	-0.8348	0.4132	.03
Bn Effectiveness, EI-4	53	2.6267	0.2154	0.0458	0.6276	.15
Bn Effectiveness, EI-4	55	2.638	0.1865	-0.1850	-0.2027	.15
Bn Effectiveness, NCO	53	2.5187	0.3641	0.5014	1.1482	.15
Bn Effectiveness, NCO	55	2.5216	0.2817	0.5027	0.6070	.15

Table 3-4. DESCRIPTIVE STATISTICS FOR "EFFECTIVENESS" MEASURES
(Continued)

VARIABLE	N	$\bar{X}$	SD	SKEW	KUR	P
Bn Effectiveness, Officer	53	3.1000	0.4429	0.1481	0.7511	.15
Bn Effectiveness, Officer	55	3.0773	0.5509	0.2686	-0.7300	.15
Bn Effectiveness, Bde Cdr.	31	-0.0010	0.8772	-0.3929	-0.1793	.54
Bn Effectiveness, Bde Cdr.	35	-0.0143	0.8919	-0.1596	-0.7564	.37
Bn Effectiveness, Asst. Div. Cdr.	27	-0.0174	0.8257	-0.5844	-0.6084	.08
Bn Effectiveness, Asst. Div. Cdr.	38	0.0003	0.8935	-0.1448	-1.1091	.16
Bn Effectiveness, Div. Cdr.	35	0.0003	0.9095	-0.2063	-0.5231	.76
Bn Effectiveness, Div. Cdr.	35	1.0010	0.9435	-0.4726	-0.8945	.02

not appropriate for parametric, multivariant analyses because of the level to which they are aggregated. Aggregating the data from company to battalion level reduced the Ns per variable by a factor of approximately five. The resulting Ns per data wave are too small to produce reliable multiple correlations or to yield reliable results from a factor analysis. The problem of too small an N for such analyses cannot be overcome through quadrupling the N by averaging correlations across four waves of data, for to do so is tantamount to using the same correlations four times each. Each wave of data was collected on approximately the same group of battalions and some personnel may have responded in more than one wave.

Even though multivariate analyses of the data were inappropriate, several potentially answerable questions remained. These included whether any of the measures were highly correlated with measures of another group (e.g., readiness indicators with command indications) and whether it was appropriate in previous studies to average the correlations across waves. To answer these questions, zero order correlations were computed between all of the "effectiveness" measures and the personal judgement scores obtained from both interviews and the questionnaire. The coefficients for these correlations for wave 3 data are shown in Table 3-5 and in Table 3-6 for wave 4 data. Under each coefficient is the probability of the null hypothesis associated with the correlation, and the number of pairs of observations used to compute it.

One of the more notable aspects of the data in the tables is the size of the Ns--they are much smaller than those in Table 3-4 which showed Ns per variable. The reason for this is that the Ns in Table 3-5 and 3-6 are based on pairs of observations, not total number of single observations as are those of Table 3-4. Thus some of the correlations are based on very small Ns, such as the N of two for the correlation between ARTEP and AGI in Table 3-5. In fact, the N's for all the correlations involving ARTEP range from 5 to 9 for wave 3 and from 3 to 12 for wave 4. The Ns for AGI range from 2 to 11 for wave 3 and from 4 to 18 for wave 4. Another notably small group of Ns for both waves are those for equipment readiness which range from 5 to 18 and from 3 to 20 for the two waves. The majority of Ns are 35 or less.

Table 3-5. INTERCORRELATIONS FOR WAVE THREE DATA

	OVERALL READINESS	PERSONNEL READINESS	EQUIP ON HAND	EQUIPMENT SERVICE	TRAINING READINESS	WEEKS TO READINESS	EQUIPMENT READINESS	EXPEDITED DISCHARGE	ADVERSE DISCHARGE	ARTICLE 15	COURTS-MARTIAL	AWOL	DESERTIONS	FIRST-TERM REEN	CAREER REEN	CRIMES OF VIOLENCE	CRIMES AGNST PROPERTY	DRUG ARRESTS	APTEP	AGI	BN EFFECT E1-4	BN EFFECT MCO	BN EFFECT OFF	BN EFFECT BDE CDR	BN EFFECT AST DIV CDR
PERSONNEL READINESS	46** 33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EQUIP ON HAND	61** 42	03 33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EQUIP SERVICE	19 43	-15 34	35* 43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRAINING READINESS	14 43	34* 34	-18 43	04 44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WEEKS TO READINESS	07 42	19 33	-23 42	-03 43	73** 43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EQUIPMENT READINESS	-30 17	02 18	21 18	-83** 18	-10 18	-07 18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EXPEDITED DISCHARGE	19 33	25 30	-06 33	-32 34	20 34	-06 33	-17 17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ADVERSE DISCHARGE	13 32	36* 31	-08 32	06 33	17 33	07 32	0 17	18 36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ARTICLE 15	03 34	03 31	-17 34	-19 35	12 35	17 34	04 17	-09 35	34* 36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COURTS-MARTIAL	19 38	34 30	-23 38	05 39	24 39	22 38	-43 17	23 36	29 35	17 39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AWOL	09 35	14 29	18 35	23 36	-19 36	-18 35	-12 16	09 33	14 34	21 38	-09 40	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DESERTIONS	-14 35	-05 29	-07 35	-20 36	-09 36	-13 35	-16 16	-13 33	02 34	11 38	14 40	28 43	-	-	-	-	-	-	-	-	-	-	-	-	-
FIRST-TERM REEN	-04 33	18 31	-34* 33	-21 34	28 34	18 33	-11 17	40* 32	21 33	24 35	58** 34	-16 35	-14 35	-	-	-	-	-	-	-	-	-	-	-	-
CAREER REEN	-08 33	0 31	-36* 33	-08 34	10 34	19 33	-31 17	19 32	17 33	25 35	26 34	-25 35	-33 35	65** 40	-	-	-	-	-	-	-	-	-	-	-
CRIMES OF VIOLENCE	-06 38	-01 29	-24 38	-10 39	-02 39	01 38	-33 17	-06 36	-03 34	12 37	-07 41	-02 40	09 40	-09 34	-16 34	-	-	-	-	-	-	-	-	-	-
CRIMES AGNST PROPERTY	16 39	19 30	-04 39	23 40	23 40	20 39	-64** 17	13 36	04 35	14 38	26 42	27 41	19 41	30 35	14 35	24 44	-	-	-	-	-	-	-	-	-
DRUG ARRESTS	-02 40	16 31	-22 40	07 41	18 41	15 40	-28 17	09 37	-09 36	29 39	38* 43	07 41	-05 41	43** 35	17 35	24 44	55** 45	-	-	-	-	-	-	-	-
APTEP	-32* 09	16 08	-38 09	-06 09	63 09	68** 09	40 05	24 08	-17 07	23 07	-61 08	-30 07	-48 07	25 08	18 08	22 08	-11 08	30 08	-	-	-	-	-	-	-
AGI	-34 10	-01 07	10 10	-36 10	-53 10	-41 10	21 05	-68 07	51 07	53 09	02 11	28 10	34 10	29 09	17 09	08 11	-05 11	07 11	-1.0 02	-	-	-	-	-	-
BN EFFECT E1-4	-13 42	03 33	06 42	04 43	-24 43	-16 42	-08 18	-11 36	02 35	-37* 38	-20 42	-28 41	-17 41	-05 39	02 39	10 42	-21 43	-08 44	-30 09	-04 12	-	-	-	-	-
BN EFFECT MCO	-02 42	11 33	04 42	-23 43	-24 43	08 42	02 18	01 36	04 35	-09 38	-05 42	-39* 41	-29 41	-05 39	16 39	03 42	-35 43	-11 44	-04 09	25 12	57 53	-	-	-	-
BN EFFECT OFF	04 42	01 33	-03 42	-28 43	-10 43	22 42	40 18	01 36	03 35	08 38	-04 42	-08 41	-36 41	0 39	11 39	-01 42	-29 43	-06 44	-08 09	22 12	20 53	67** 53	-	-	-
BN EFFECT BDE CDR	-29 25	-20 18	-19 24	-27 25	-25 25	-19 25	-18 10	-08 23	30 21	02 22	0 24	-11 24	34 24	03 24	08 24	13 26	-44 26	-28 26	-36 06	26 07	51** 30	54** 30	36* 30	-	-
BN EFFECT AST DIV CDR	13 21	-08 21	28 21	-15 22	-15 22	-23 21	21 12	40 22	14 23	-18 23	20 22	-39 24	-27 24	21 24	01 24	-34 21	-20 22	09 22	-33 06	55 03	19 27	35 27	16 27	50 15	-
BN EFFECT DIV CDR	-21 29	-21 24	-02 29	-37* 30	-15 30	-14 29	04 13	0 27	-02 26	03 27	-10 29	-65** 28	16 28	17 28	16 28	-14 29	-41* 30	-19 30	37 6	58 4	1 34	42 34	27 34	51 22	67 25

* P<.05
**P<.01

Table 3-6. INTERCORRELATIONS FOR WAVE FOUR DATA

	OVERALL READINESS	PERSONNEL READINESS	EQUIP ON HAND	EQUIPMENT SERVICE	TRAINING READINESS	WEEKS TO READINESS	EQUIPMENT READINESS	EXPEDITED DISCHARGE	ADVERSE DISCHARGE	ARTICLE 15	COURTS-MARTIAL	AWOL	DESERTIONS	FIRST-TERM REEN	CAREER REEN	CRIMES OF VIOLENCE	CRIMES AGNST PROPERTY	DRUG ARRESTS	ARTEP	AGI	BN EFFECT E1 - 4	BN EFFECT NCO	BN EFFECT OFF	BN EFFECT BDE CDR	BN EFFECT AST DIV CDR
PERSONNEL READINESS	70** 49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EQUIP ON HAND	09 49	-34* 49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EQUIP SERVICE	14 49	-20 49	14 49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRAINING READINESS	51** 49	76** 49	-28 49	-36* 49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WEEKS TO READINESS	58** 49	76** 49	-24 49	-25 49	91** 49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EQUIPMENT READINESS	-24 20	07 20	-31 20	-90** 20	28 20	12 20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EXPEDITED DISCHARGE	-11 35	-14 35	-09 35	21 35	-34* 35	-26 35	-27 20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ADVERSE DISCHARGE	06 35	04 35	-07 35	-12 35	05 35	0 35	07 20	-17 38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ARTICLE 15	24 37	-09 37	15 37	44* 37	-12 37	-04 37	-04 20	43 38	13 38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COURTS-MARTIAL	35* 38	37* 38	-11 38	-10 38	23 38	37 38	-06 20	25 38	-04 38	14 40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AWOL	23 38	01 38	04 38	51** 38	-21 38	-10 38	-25 20	-18 38	26 38	22 40	-07 41	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DESERTIONS	18 38	01 38	06 38	30 38	-17 38	-07 38	-29 20	-01 38	07 39	02 40	01 41	54** 42	-	-	-	-	-	-	-	-	-	-	-	-	-
FIRST-TERM REEN	28 34	44* 34	-21 34	-32 34	27 34	29 34	38 20	03 36	-04 36	03 36	40* 36	-06 37	-03 37	-	-	-	-	-	-	-	-	-	-	-	-
CAREER REEN	02 35	-03 35	-20 35	18 35	09 35	-04 35	-19 20	-09 36	08 36	04 36	05 36	-05 37	06 37	43* 40	-	-	-	-	-	-	-	-	-	-	-
CRIMES OF VIOLENCE	16 38	-03 38	40* 38	-12 38	-04 38	-03 38	-07 20	0 38	-09 38	-03 40	24 41	-15 42	-01 42	0 37	08 37	-	-	-	-	-	-	-	-	-	-
CRIMES AGNST PROPERTY	11 38	-01 38	17 38	-02 38	0 38	01 38	14 20	-19 38	-19 38	02 40	-12 41	07 42	01 42	12 37	07 37	53** 42	-	-	-	-	-	-	-	-	-
DRUG ARRESTS	-07 38	10 38	02 38	-08 38	19 38	20 38	-03 20	-02 38	-03 38	07 40	06 41	-05 42	11 42	28 37	24 37	11 42	33* 42	-	-	-	-	-	-	-	-
ARTEP	-63 09	-82* 09	35 09	-57 09	-41 09	-34 09	71 03	-02 11	-08 11	33 11	-56 12	21 12	-16 12	-09 10	-14 10	10 12	27 12	26 12	-	-	-	-	-	-	-
AGI	-06 17	-03 17	-07 17	-63* 17	04 17	-07 17	85** 10	02 16	-27 16	-43 18	04 18	-41 18	-17 18	26 17	-38 17	01 18	-04 18	-02 18	12 4	-	-	-	-	-	-
BN EFFECT E1-4	-16 49	10 49	03 49	-26 49	07 49	02 49	32 20	-07 38	-02 38	-08 40	30 41	-47** 42	-39* 42	15 40	19 41	37* 42	12 42	-03 42	-40 12	35* 19	-	-	-	-	-
BN EFFECT NCO	-05 49	-28 49	41** 49	-05 49	-14 49	-18 49	07 20	-09 38	-11 38	-15 40	-26 41	-24 42	04 42	-08 40	24 41	14 42	-11 42	-03 42	07 12	22 19	23 55	-	-	-	-
BN EFFECT OFF	-25 49	-21 49	06 49	-34* 49	-07 49	-13 49	44* 20	-15 38	-10 38	-21 20	05 41	-37* 42	-45** 42	09 40	07 41	30 42	21 42	-08 42	12 12	35 19	59** 55	41** 55	-	-	-
BN EFFECT BDE CDR	-13 33	-10 33	-14 33	0 33	-06 33	-02 33	-24 15	01 26	-15 26	-04 27	-08 27	-11 28	-22 28	-12 27	04 28	03 28	-07 28	-33 28	-05 5	04 10	42* 35	32 35	47* 35	-	-
BN EFFECT AST DIV CDR	-02 33	-01 33	-22 33	12 33	09 33	24 33	-04 15	04 27	-30 27	15 29	39* 30	-13 30	-05 30	15 29	-06 29	02 30	03 30	04 30	-39 8	36 13	54* 22	40* 38	-25 38	21 38	-
BN EFFECT DIV CDR	-13 31	05 31	-13 31	-23 31	-05 31	0 31	26 13	21 23	-26 23	13 25	47* 26	-47* 26	-31 26	34 23	-16 23	20 26	01 26	03 26	-17 7	56* 16	80** 28	37 19	35* 35	-21 35	30 35

* P .05
** P .01

Although 27 of the 300 correlations of Table 3-5 and 43 of the 300 correlations of Table 3-6 are significant, few of those found to be significant in the O'Mara (1981) paper are significant for either wave 3 or 4 (of course the correlations in the O'Mara paper have large Ns and thus smaller standard errors). For example, the O'Mara paper listed 19 of the 21 correlations on readiness measures as significant and 21 of the 55 correlations on the command indicators as significant. However, for wave 3 data, only 6 of the 21 correlations on the readiness measures are significant and only 5 of the 55 correlations for the command indicators are significant.

Tests of the differences between wave 3 and wave 4 correlations on the same variables were calculated in order to assess the appropriateness of averaging the correlations across waves. While the tests were made on correlations based on wave 3 and 4 and not correlations for wave 1 and wave 2 data, the results are generally negative--there are few statistically significant differences between the correlations. Specifically, only 9 of the 300 pairs of correlations were significantly ($p < .05$) different. Of these 9, only 3 were between variables whose correlations were averaged in one of the previous studies. Moreover, one would expect more than 9 of the 300 test to yield significant results just on the basis of sampling errors. Thus it appears appropriate to average the wave 3 and 4 correlations and possibly those for all waves.

The tables of correlations also show some interesting and potentially useful correlations between members of different groups of "effectiveness" measures. They include the following for two of the measures ranked and rated as two of the best indicators of effectiveness in Kerner-Hoeg and O'Mara (1981):

Junior Officers' Judgements of Effectiveness with Equipment Readiness

Wave 3: $r = .40 (p < .1)$
Wave 4: $r = .44 (p < .05)$

NCOs' Judgements of Effectiveness with AWOL

Wave 3: $r = .39 (p < .05)$

Junior Officers' Judgements of Effectiveness with AWOL

Wave 4: $r = .37 (p < .05)$

Other than these, few of the measures were significantly correlated with measures from other groups.

3.4 DISCUSSION

Based on the critical review and re-analysis of the results of the research described, the following seven command climate variables are recommended as having some potential to predict the effectiveness of battalions at the NTC:

- NCOs' Judgements of Battalion Effectiveness
- Junior Officers' Judgements of Battalion Effectiveness
- Brigade Commanders' Judgements of Battalion Effectiveness
- Battalion ARTEP Scores
- Annual General Inspection (AGI) Results for Battalions
- Equipment Readiness Indicator in a Battalion's USR
- AWOL Rates in a Battalion's USR

It must be stressed that these variables represent <u>potentially</u> valid predictors. To be of real value they must be subjected to rigorous validation.

The following sections describe the operational definitions and rationales for selecting the seven variables.

<u>NCOs', Junior Officers', and Brigade Commanders' Judgements of Effectiveness</u>. The foremost reason for proposing all three of these variables as predictors is that they were rated the second, third, and fifth best single indicators of battalion effectiveness in the Kerner-Hoeg and O'Mara (1981) study. Secondly, all three were highly and significantly intercorrelated in the O'Mara study and in the analyses SAIC calculated for both waves

3 and 4. None of the other types of personal judgements were rated as highly in the Kerner-Hoeg and O'Mara study. Also, the correlations between the judgements of NCOs and the judgements of others (e.g., division commanders) were low, as were the correlations between junior officers judgements and those given by others.

Because of their numbers per battalion, it is recommended that the judgements of NCOs and junior officers should be obtained on a single rating scale rather than through interviews. These scales should be Likert type scales such as those used on the command climate questionnaire (shown in Appendix C) although seven point scales should be used rather than five point scales in order to increase variability.

Because of their rank, it is recommended that the judgements of brigade commanders should be obtained as they were for the Command Climate Data--in personal interviews. The same type of procedures should be followed as were used for the Command Climate Data. However, the 13 point scale used for the Command Climate Data should be reduced to a seven point scale as that would be more reliable than one with 13 points.

ARTEP and AGI. Both of these measures were, as the previous three, rated by senior officers as being some of the best indicators of a battalion's effectiveness. ARTEP and AGI were ranked first and fourth in the Kerner-Hoeg and O'Mara study in terms of their accuracy as indicators of effectiveness. Based on either the wave 3 or wave 4 data, neither of these were correlated very highly with the three previous indicators, or with each other. However, as the correlations of wave 4 data indicate, the number of observations available to calculate a correlation between ARTEP and AGI were only two and four respectively, which makes it clear why they were not highly correlated. Moreover, the number of pairs of observations available to calculate a correlation between ARTEP or AGI and the personal judgement measures was less than 12 and sometimes as few as three. Similar size Ns probably partially account for the lack of correlation between ARTEP and AGI in O'Mara (1981).

The operational definitions of both ARTEP and AGI are those used in several of the previous studies. In all these cases ARTEP was defined as "the percentage of the missions/tasks rated 'satisfactory' during a

battalion's most recent field training exercise." AGI was defined as "the percentage of the areas rated 'satisfactory' during a battalion's most recent annual general inspection."

Equipment Readiness. This is a measure of the proportion of a battalion's equipment on hand which is operable. Thus, in contrast to the other equipment related measures of the USR, this measure primarily indicates the efficiency of a battalion's maintenance system. This system could influence a battalion's long term performance in the field and at the NTC. This measure is proposed as a predictor because it is also correlated highly with ARTEP and AGI (.54, $p < .01$; .40, $p < .01$) in the O'Mara (1981) study and with junior officers' judgements of effectiveness for both waves 3 and 4 (.40, $p < .10$; .44, $p < .05$).

The operational definition of this measure is the same as used in several of the previous studies. It is taken from the USR and is "the proportion of equipment a battalion actually has on hand that is operational."

AWOL. This measure is proposed with less support than the previous six. However, its correlations with the judgements of NCOs and officers are impressive: .39($p < .05$) in wave 3 for NCOs; and .37 ($p < .05$) for officers in wave 4. Moreover, AWOL was rated as the best single indicator of a battalion's effectiveness by 18 percent of the senior officers in the O'Mara study (1981). It probably is a reflection of a battalion's morale and is a readily available measure which should be reliable because of the methods used to calculate it.

The operational definition of this measure is the same as in several of the previous studies. It is taken from the USR and is "the percentage of enlisted personnel who were involved in unexcused absences during a given month."

Section 4
COMMAND GROUP BEHAVIOR STUDIES

4.1 BACKGROUND

One of the original objectives of this project was to analyze the Command Group Performance in CATTS study (cf. Archer et al., 1984) to identify potential predictors of effectiveness at the NTC. At the suggestion of the government, two other studies of command group behaviors were included in the scope of this objective. The studies were FORGE I (Factors in Military Organizational Effectiveness) (Olmstead et al., 1973) and Cardinal Point II (Olmstead et al., 1978). Thus this chapter contains the results of the reviews of all three studies, a group of suggested predictors of effectiveness at the NTC, and suggestions about how the potential predictors may be operationally defined and measured.

Each of the three studies involved the observation of command groups involved in simulated command and control exercises. In each, the command groups' behaviors were classified and evaluated relative to various estimates of the effectiveness of the groups' performance. This review focuses on the nature of these relationships.

In the Command Group Performance in CATTS study, command groups were observed while engaged with CATTS at Ft. Leavenworth, Kansas. Extensive recordings were made of the information management behaviors of battalion commanders and their staffs as they under went training at the facility--"fighting" in a highly realistic computer-assisted simulation. The recordings were then coded to measure the groups' behavior.

Both the FORGE I and Cardinal Point II studies were conducted by the Human Resources Research Organization (HumRRO) and both studies relied on the PEGASUS simulation. This simulation used a mixture of computer and human controllers to provide the inputs to the command group exercise. Nonparticipants rated the performance of the groups across several different behavioral classifications and the ratings were then correlated with experts' ratings of the groups' effectiveness.

The next three sections of this chapter present a more detailed description of each of the three studies and their findings. The following section summarizes the results and in the final section of this chapter the three sets of results are integrated and the variables of the studies that have the most potential as predictors of battalion effectiveness are delineated. In addition, methods are suggested for measuring each of the potential predictors.

4.2 APPROACH TO THE STUDY OF COMMAND GROUP BEHAVIORS

4.2.1 Command Group Performance in CATTS Study
(cf. Archer, Fineberg, and Carter, 1984)

The Command Group Performance in CATTS Study analyzed in detail the activities of battalion command groups engaged in computer driven battle simulations. All activities were recorded using video cameras, general area microphones, and tape recordings of telephone communications by which the command group communicated with other echelons and with the dispersed portions of the command group (e.g., JTOC and TRAINS).

The operations orders (OPORD) and recordings for a number of battalions were analyzed for the quality and quantity of the performance of several behaviors, and the results of the analyses were correlated with ratings of the command groups' effectiveness. In general, the results indicated that selected information processing behaviors, especially those regarding the planning and transmitting of information, may influence battalion effectiveness.

4.2.1.1 Procedures. CATTS, a high fidelity, computer-driven, battalion-level simulation, which was instrumented for this study with audio/visual recording technologies, provided the facility for this research project. CATTS portrays the movements of both friendly and enemy units, engagements of these units, weather, and other variables which can affect the outcome of the battle.

The members of the command group, operating within a realistic mock-up of a Tactical Operations Center (TOC) equipped with the normal complement of communications equipment, talk to their "troops" through

professional "controllers" of the simulation and role-playing subordinate (company) commanders. The controllers of the simulation enter the battalions staffs' orders into the computer where the battle is simulated. An opposing force controller enters directives for the operation of the enemy units, and the computer provides him, as well as friendly controllers, "feedback" on the status of the battle. The friendly controllers relay appropriate portions of the feedback to the battalion commander and sta ᶠ.

There were three major sources of data for this study: combat outcome data generated by the computer; controllers' ratings of battalion staffs' effectiveness; and observers' classifications/evaluations of the recordings of the staffs' responses to two stimulus situations or probes. The probes involved problems communicated to the command group and their responses to them. The two probes consisted of introducing jamming of communications, and reporting the sighting of an enemy counterattack, respectively. The reviewers then coded the speed with which communications were carried out, the number of primary communication nodes involved (brigade, staff sections, battalion commander, and company commanders) and the node pairs (or dyads), the nature and frequency of the information passed, and the relative frequency of the different types of communications processed.

4.2.1.2 Results. Overall the results showed that for the battalion command groups to be effective in the CATTS exercise, they must be effective information processors. The command groups must transmit information quickly, clearly, and accurately. They must actively seek out information about the battlefield and predict what may happen there. They must be able to make decisions rapidly in response to incoming information. They must not waste time clarifying information, or discussing command decisions.

Controller ratings appear to be influenced more by "professionalism" in communication, and managerial style, rather than effectiveness of information management. Controllers' ratings were higher as command groups received more days of training, for shorter transmission times, and higher quality transmissions. The controllers' ratings of command group performance were not significantly related to any of the measures of simulated combat outcome (loss exchange ratios, relative exchange rates, surviving maneuver force ratio differential, change in combat ratio, and weighted

force measures). In fact, all of the correlations between controllers' ratings and the combat outcome measures were negative (although insignificant) and in one correlation the average time of transmissions was positively related to favorable loss exchange ratios but negatively related to controllers' subjective ratings.

Battalion command groups with good simulated battle outcomes spent much of their time communicating information. More successful groups, distributed information widely, and spent much time seeking information about the battle and discussing possible future developments of the battle. They also successfully transmitted more whole messages than poor performing command groups and had to issue fewer communications concerning courses of action to be taken.

4.2.1.3 Evaluation of Study. This study contained some problems which were related to its small sample size, the complexity of the exercises, and the lack of inter-rater reliability. The sample size was a problem because only five battalion command groups were studied. While repeated measurements were made, such a small sample of command groups cannot be considered to be a representative sample. Thus, at the least, the study suffers from a lack of generalizability.

In addition, the exercises the participants engaged in were so complex and uncontrolled that it was practically impossible to isolate the effects of most factors. Thus there was probably a great deal of confounding of effects. Similarly, very few effects achieved statistically significant levels.

Finally, the inter-rater reliability for observers was very low. The highest correlation coefficient for these reliability measures was .70. Obviously such reliabilities also contributed to the dearth of significant findings.

In spite of these problems, some potentially valuable findings were obtained. These include the observation that the effective transmission of information appears to be the most critical aspect of command group performance. Much more time is spent in gathering and transmitting information than in making command decisions. If the commander and S3 have enough

information, decisions appear to automatically flow from the information. Not only must each individual transmission be made accurately, completely, and on time (three traditional criteria for command and control communications), but information must also be widely distributed. Particular care must be taken in communicating coordinates, the most frequent source of communication errors. Effective command groups should also devote as much time as possible to actively seeking out information that might help predict how the battle will develop.

4.2.2 FORGE I (Olmstead, Christensen, and Lackey, 1973)

The FORGE I study was conducted by the Human Resources Research Organization (HumRRO). The study investigated organizational competence by evaluating ten battalion command groups engaged in the PEGASUS simulation of a South East Asia battle scenario. Transcriptions of the exercises were coded for type and quality of communications, and effectiveness of the groups' responses to 128 different stimulus or probe events in the exercise.

The stated objective of the study was to develop an overall measure of organizational competence. Competence was measured in terms of the effective performance of seven basic organizational processes: sensing, communicating information, decisionmaking, stabilizing, communicating implementation, coping actions, and feedback (see Table 4-2). The results showed that a number of the processes were strongly related to the effectiveness of the command groups. However, there was no evidence that the seven processes are all strongly related to a single underlying construct such as competence.

4.2.2.1 Procedures. The focus of the study was organizational competence, defined as the capacity of an organization to cope with a continuously changing environment. Organizational competence was believed to result from seven basic organizational processes (see Table 4-1). The project studied U.S. Army infantry battalions because they were believed to be a prime example of an organization that must continually adapt to fast-changing environmental conditions.

Table 4-1. PROCESS DEFINITIONS

SENSING	The process by which an organization acquires and processes information about its internal and external environments.
COMMUNICATION INFORMATION	The process of transmitting information that is sensed to those parts of the organization that can act upon it.
DECISIONMAKING	The process of making decisions concerning actions to be taken as the result of sensed information.
STABILIZING	The process of taking actions to adjust internal functioning and maintain organizational stability integration that might otherwise be disrupted as a consequence of actions taken to cope with changes in the organization's environments.
COMMUNICATING IMPLEMENTATION	The process of transmitting decisions and decision-related orders and instructions to those parts of the organization that must implement them.
COPING ACTIONS	The process of executing actions intended to cope with changes in the organization's environments.
FEEDBACK	The process of evaluating the results of a prior action through further sensing of the external and/or internal environments.

The general approach the study adopted was to simulate the activities of an infantry battalion engaged in a stability operation in Vietnam. The simulation involved role-playing, in which officers played the roles of 12 key positions in the battalion. The simulation lasted eight hours and occurred in four phases, three of which differed in the intensity of environmental pressure. Pressure was determined by the frequency and complexity of stimuli or probes which were presented as part of the exercise. The scenario was designed to present 128 interrelated probes. Each probe consisted of a set of inputs related to a single event, e.g., the crash of a friendly helicopter behind enemy lines. Players were free to react spontaneously to the probes in any way they chose. The importance of each probe was determined by the expert military judgement of three retired military officers.

Each exercise consisted of three phases. The low pressure phase required a slow moving routine patrolling operating. The medium intensity scenario began with a radical change in mission and continued with a requirement for the planning and execution of an air assault. The high intensity phase involved intense combat, a high frequency of inputs and a host of problems that were both complex and critical to the survival of the unit.

Officers comprising the command groups were selected from the non-student officers at Ft. Benning, Georgia, who had experience in Vietnam. They were assigned to role-play positions in a command group which they had held in combat. The officers selected ranged in grade from senior major to first lieutenant. They were placed in 10 command groups of 12 men each.

Transcripts of each session were divided into sets of communications relating to each of the 129 probes. Then the frequency and quality of each of the seven basic organizational processes which occurred during each session were determined. The overall effectiveness of a command group's responses to the probes were rated by matching a groups' responses to a set of possible responses which had been previously generated and rated for effectiveness by a panel of experts.

4.2.2.2 Results. Within the limitations of the experimental design, this study shows that the most critical process in C2 is gathering and communicating information. Of the seven processes, sensing information was the most strongly related to effectiveness. It also was the most frequent type of communication. Sensing information was followed closely by communicating information sensed. Messages involving coping actions, communicating implementations, and decisionmaking were also reliably related to effectiveness, although not as strongly, and occurred only about half as frequently. Communications involved in stabilizing and feedback did not occur frequently enough for analysis.

According to this study the quality with which information is communicated may be the best single predictor of command group effectiveness. A multiple regression analysis indicated that communicating information sensed accounted for 44% of the variance of effectiveness, sensing information accounted for 19%, and the quality of decisionmaking for 14 percent.

Not only is the quality of decisionmaking more weakly related to effectiveness than sensing and communicating information, but decisionmaking also depends upon the quality of those processes. Command groups that received low scores for both sensing and communicating information were three times more likely to produce low quality decisions. Without good information, it is very hard to make good decisions.

Being able to handle high information loads was found to be a critical feature of effective battalion command groups. Effective command groups managed to successfully transmit almost all messages, even under high pressure conditions. Low effectiveness groups, however, could not keep up under high pressure. For example, while low effectiveness command groups had only slightly more aborted decisions during the low and medium pressure phases, under high pressure they aborted more than three times as many decisions as high effectiveness groups. Aborted decisions were decisions that were not followed by implementing actions (see Figure 4-1).

4.2.2.3 Evaluation of Study. The FORGE I study appears to be quite methodologically sound. Within the limits of the validity of the simulation (which did not use existing command staffs but was rated as highly realistic

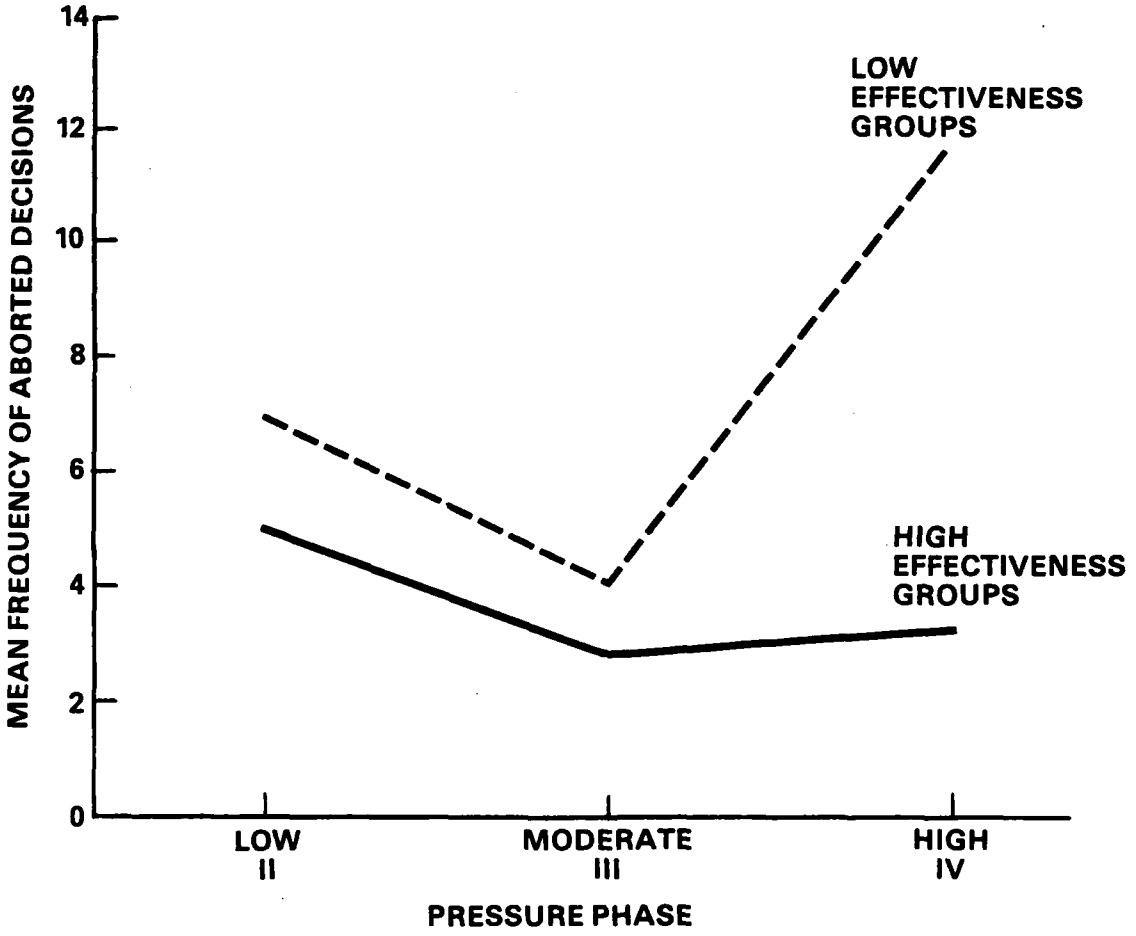

Figure 4-1. ABORTED DECISIONS OF HIGH EFFECTIVENESS AND LOW EFFECTIVENESS GROUPS (Olmstead et al., 1973)

by participants) and the measurement of effectiveness (based on a large number of probes judged quite objectively), the results should generalize to performance in battle, and at the NTC. However, the broad thesis that "Organizational Competence is a principal determinant of the effectiveness of organizations" (p. ix) was not substantiated. While a number of the seven processes were related to effectiveness, there is no empirical evidence that these particular seven processes are the best or the only way to categorize command group behaviors. Some other categorization scheme may be more informative. Further, it is not clear that there is any advantage gained by combining the processes into an overall competence score rather than treating them separately.

The results of this study clearly indicate that to be effective, command groups must aggressively seek out and effectively communicate information. While it helps to have good decisionmaking, it is more important to have good information and make sure that information gets to everyone who needs it. The quality of command decisions depends more upon having good information than upon having a good decisionmaker. The importance of acquiring and communicating information for effective battalion performance was clearly demonstrated, and should not be ignored.

4.2.3 **Cardinal Point II** (Olmstead, Elder, and Farsyth, 1978)

Cardinal Point II was a large training exercise performed by the U.S. Army's 8th Infantry Division in the summer of 1978. HumRRO formed a team to study the effectiveness of using Organizational Effectiveness Staff Officers (OSEOs) to observe command group performance. The study employed a conceptual framework similar to FORGE I. Cardinal Point II also had command groups train with PEGASUS, but the command groups were actual, already existing command staff groups.

Despite some methodological problems, the results of this study largely replicate those of FORGE I. Process performance scores were based upon subjective estimates of single OESOs, and no tests of inter-rater reliability were reported. However, as in the previous study, gathering and transmitting information were found to be the most important predictors of performance in the exercise.

4.2.3.1 Procedures. Data were collected on 12 battalions (seven Mechanized Infantry and five Armor) in association with Cardinal Point II training exercises. Each battalion participated in an 11-day exercise consisting of a field training exercise, a battle simulation (PEGASUS), and live firing. The data presented in the report were collected during the PEGASUS battle simulation phase. One weakness of the 1973 FORGE study was the use of "command groups" which were not already existing groups but which were composed for the study of available but unrelated officers. In Cardinal Point II, however, actual, already existing command groups were used.

The framework for this study was the same as that used for FORGE I. The Organizational Competence processes outlined in Paragraph 4.3 were observed by OSEOs during the battle simulation. The simulation was a two sided, open-manual board game in which all communications were conducted through conventional radio nets. Each iteration of the simulation required four days to complete with each module consisting of one or more types of combat operations. One OSEO was assigned to each command group during the four simulation modules. Upon completion of each module the OSEO debriefed the unit commander and rated the group on the quality of their performance in terms of the same seven processes used in FORGE I. Performance on the exercise was rated by four OPFOR controllers, based upon completion of mission requirements and conservation of resources.

4.2.3.2 Results. The primary findings of this study involve the interrelationships between the seven processes (sensing, information communication, decision-making, stabilizing, communicating implementation, coping, and feedback). Examination of the intercorrelations of the processes reveals two distinct clusters--one involving information processing and the other involving command and control (C2). The three processes which make up the information processing cluster were highly correlated with each other: sensing, information communication, and feedback. The processes that formed the C^2 cluster were: decisionmaking, stabilizing, and coping. Communicating implementations, which involves transmitting command decisions, was equally correlated with each cluster. The quality of a group's performance scores appeared to be determined by both its ability to communicate and the quality of its command decisionmaking.

The information processing variables were by far the most strongly related to controllers' ratings of mission performance. Sensing, information communication, and feedback were significantly related to estimates of battalion staff effectiveness. None of the other processes were reliably related to effectiveness.

4.2.3.3 Evaluation of Study. The use of only two OSEOs, each rating different command groups, is problematic. First, there are major questions about inter-rater reliability. The OSEOs' ratings had to be standardized because one gave considerably higher ratings than the other. Neither OSEO rated both groups, so it is impossible to verify the reliability of their ratings. The second problem involves their making process ratings only once at the end of each module. It is difficult to know if the observers were actually sensitive to each of the seven processes, or just responding according to their subjective impressions of the group's performance on one or two general dimensions. The strength of the two clusters of variables indicates that the OSEOs actually may have formed impressions of only two factors--how well the command group processed information, and the quality of their command decisions. However, despite these problems, the results of this study support those of FORGE I.

Effective acquisition and communication of information is the hallmark of an effective battalion command group. The information processing cluster was strongly related to performance. Decisionmaking ability, on the other hand, was not reliably related to effectiveness. At the battalion level, at least, command groups that can find out what is happening and stay in control of the flow of communications will do the right thing, even if they are not the most brilliant tacticians.

4.3 RESULTS SUMMARY

The results of these three studies are remarkably consistent. Battalion command group performance is largely dependent on effectively gathering and transmitting information. While the quality of decisionmaking is related to command group performance, it is largely dependent on the quality of information available to decisionmakers and the group's ability to manage the information flow.

The ability of a battalion to properly process combat information should be strongly related to its ability to function effectively. Conceptually, the command group is similar to any other information processing system. It receives inputs, processes the information, and generates outputs. The information inputs to a battalion include incoming intelligence and communications as well as information on standard procedures, strategy and tactics. The information processing involves transmitting the information to the proper recipients, transforming and correlating it into usable forms, storing it, and making decisions. The outputs consist of all communications sent from the command and control group, including simple relaying of information, requests for more information, or communicating command decisions.

4.4 DISCUSSION

Based on the studies reviewed, there are a number of components which contribute to effective information processing. First, battalion command groups must actively seek out information about their environment. The better the picture they have about what is happening around them, the better will be their performance. This includes not only sensing enemy activities, but also learning about friendly activities, getting feedback on the implementation of previous orders, learning more about strategy and planning from higher echelons, maintaining contact with adjacent battalions, etc. The essential element of this process is the active seeking of information. If you wait for what you need you may not be around to use it. Second, the quality of communication is vital. Everyone involved in the transmission of information must be able to communicate quickly, clearly and concisely. To do this, all personnel involved, from the radio operator in the field on up, must know what to communicate, who to communicate it to, and how to communicate the information. Particular care must be taken to insure that messages are not lost or distorted. Coordinates and CEOI information appears to be particularly prone to errors. An adequate division of labor may help insure that central personnel will not be overloaded in high pressure situations. Finally, dissemination of information is important. The more informed everyone is, the more able they will be to facilitate information processing and decisionmaking.

As the result of integrating the findings of the three studies, seven specific information processing variables are suggested as important for battalion performance and are recommended as potential predictors of effectiveness at the NTC. The variables are:

- Information Seeking - the time (or proportion of communications) spent actively gathering information.
- Communication Efficiency - the ability to transmit required information in brief and explicit terms.
- Communication Accuracy - the ability to transmit information without errors or omissions.
- Completed Communications - the proportion of communications that actually arrive at their intended destination.
- Communication Timeliness - the proportion of communications received in time to achieve their intended purpose.
- Information Dissemination - the extent to which information is distributed to all personnel who may be able to use it.
- Decisionmaking Quality - the ability of command staffs to rapidly make appropriate command decisions.

Unfortunately, there are no readily available, objective measures of these variables for most battalions. Command group performance is evaluated both in garrison and during field training exercises (FTX) and command post exercises (CPX). However, these evaluations generally produce narrative feedback, not numerical estimates of specific variables which could be used to predict NTC performance. Some additional data collection or reduction will be needed to adequately measure these variables.

Two different approaches should yield valid indicators of battalion command groups' performance on the seven variables mentioned above. The first method relies on existing written evaluations of a command group's performance in CPX or FTX. These evaluations could be reviewed by trained

coders who would then rate the command group on each of the seven variables. The second approach would require observers in FTX and CPX to be trained to recognize the performance of relevant behaviors and then to rate the command group on each variable.

All battalions usually have available several written evaluations of their command group's performance in FTX and CPX exercises, and other Army Training and Evaluation Program (ARTEP) events. These evaluations provide some measures of the unit's ability to manage information and accomplish assigned tasks. A major portion of the ARTEP standards deals with command and control performance. For example, in ARTEP 71-2 (for mechanized infantry/tank task forces), all of paragraphs 3-I-1-1 to 3-I-1-16, and portions of paragraphs 3-I-2, 3-I-3, 3-I-6, 3-VI, and 3-VII provide specific standards for command and control performance in a variety of situations. Major ARTEP evaluations at the battalion level take place every twelve to eighteen months, and the written evaluation is a part of the battalion's records. While the methods for conducting and reporting on ARTEP exercises are not standardized, they should provide adequate detail for trained personnel to score the battalion on the seven suggested variables. These scores could be based on a relatively simple rating scale (such as Unacceptable, Marginal, Average, Above Average, and Excellent). The personnel scoring the ARTEPs and similar data should be trained and tested to insure the inter-rater reliability of their ratings.

Similarly, the Annual General Inspection (AGI) reports and Training Inspection reports from Major Command Headquarters concentrate on the process of how information is managed by units in all sections. Like the ARTEPs, these evaluations may be scored to estimate battalion performance on the seven variables.

It would be even more desirable to have estimates of battalions' performances on the seven factors rated by personnel who actually observed FTX and CPX. The Cardinal Point study demonstrated that observers could be quickly trained to observe command group functioning, and were well received by the personnel being observed. It should be possible to train personnel, already involved in observing and evaluating command group functioning during training exercises, to provide additional ratings on the variables suggested here, which could be included with their written evaluations of

the exercise. In the long run the estimates by personnel who actually observed the command group's performance may provide the most reliable data for predicting battalion performance at the NTC.

Summary. The performance of a battalion command group largely depends upon its ability to gather, transmit, and distribute information. These abilities may be assessed by measures of information processing quality in field training exercises and simulations. Improving these qualities should have a major impact on the battalion's performance in battle, and at the NTC.

Section 5
ORGANIZATIONAL EFFECTIVENESS STUDIES

5.1 BACKGROUND

One of the goals of this project was to review the relevant Organizational Effectiveness studies based on AMORE, in order to identify potential predictors of effectiveness at the NTC. This chapter describes the results of the review of such studies.

AMORE is a methodology developed to measure a unit's capability, particularly after the unit had suffered some theoretical personnel casualties or materiel damage. AMORE was originally developed to address five points which had been concerns associated with assessing a unit's capability. These were the needs to:

- Evaluate personnel casualties and materiel damage resulting from an attack.
- Determine the maximum unit capability using resources remaining after attack.
- Minimize the time required to achieve maximum capability.
- Present unit capability as a function of time.
- Present data on unit organizational strengths and weaknesses.

AMORE was subsequently used to study many influences on unit capability.

AMORE is a methodology (fully described in Appendix E) which is most useful for assessing the maximum potential capability of a unit. An AMORE estimate of capability is usually expressed in terms of the number of mission related teams the unit could field which are essential to the mission of the unit (Mission Essential Teams - MET). For example, a howitzer battery might be able to field five teams each composed of a 155 mm cannon and the personnel to fire and maintain it.

AMORE is especially useful for assessing a unit's maximum potential capability after the unit has suffered casualties. The reason for this strength of AMORE is that its methodology employs a matrix of substitutability estimates that indicate which personnel in a unit can effectively substitute for one another. Thus after a unit suffers casualties, the maximum number of METs a unit could field is determined by substituting some personnel for those personnel critical to a MET who had been "killed." The best substitutions throughout the unit are determined by employing a transportation algorithm.

Because of the critical relationship of unit substitutability to potential unit capability and thus effectiveness, the next section of this chapter is devoted to an examination of this relationship. The reviews of ten previous pertinent AMORE studies are contained in Appendix E and Section 5.3 summarizes the results of these reviews. Section 5.4 discusses factors which appear to be significant influences on a unit's residual capability and also provides definitions for the qualitative judgements of each of the significant factors discussed.

5.2 APPROACH TO DETERMINING THE RELATIONSHIP BETWEEN UNIT SUBSTITUTABILITY AND CAPABILITY

5.2.1 Purpose

The purpose of this section is to quantitatively describe the relationship between unit substitutability and unit capability after a unit suffers casualties (degradation). Three principal inputs drive AMORE results: the supply of resources, mission resource requirements, and the degree of unit substitutability. There is little that a unit commander can do to influence his unit's supply of resources or mission resource requirements for a given unit type. However, unit commanders can influence unit substitutability. Thus a clear mathematical relationship between unit substitutability and unit capability after degradation would help identify potential predictors of effectiveness at the NTC.

5.2.2 Methodology

Data on unit substitutability and percent of remaining capability after degradation were used in a regression analysis to determine the relationship between the two measures. Tables 5-1 and 5-2 provide a synopsis of data derived from past AMORE analyses which were used in the regression analysis. The data of seven studies are included in Table 5-1. These were the only pertinent studies, of many AMORE studies, which contained data of the type needed and in a form that permitted analysis. These studies focused on a total of 16 units, as listed in the first column of Table 5-2. Table 5-1 provides information on the study, the type of unit, the available resources and the resources required for the METs, the number of METs defined, and the remaining capability found at various degradation levels. Table 5-2 lists substitutability and remaining capability at various degradation levels for each study. Those data were then normalized to find the average difference for each unit between its capability and the objective unit degradation line, which represents decreases in unit capability equal to the amount of degradation applied to the unit. For example, at 20% degradation, the objective unit degradation line falls on the 80% capability level.

In determining the relationship between substitutability and capability, only personnel substitutability was examined since this is the area in which the commander has the greatest influence on substitutability. Substitutability as derived from past analyses was calculated using the transfer matrices, where expert judgement was used to determine acceptable substitutions, and time penalties reflect the time required for a substitute to move to his new location and refamiliarize himself with his duties. This method calculates the substitutability ratio based on the number of type positions (by grade and MOSC), instead of the total number of personnel available within the unit to use as substitutes.

The time to achieve maximum capability was the duration used to determine the percent of remaining capability after degradation, instead of a set point in time (one hour, ten hours, etc.). This was chosen because most previous analyses measured remaining capability at this point. Negative numbers in the last two columns of Table 5-1 are performance points which fall below the objective line. Additionally, all resource

Table 5-1. DATA FROM PAST AMORE ANALYSES

STUDY AND DATE	UNIT	RESOURCES (PERS) AUTH	RESOURCES (PERS) REQ	# METS FORMED	SUBSTITUTABILITY RATIO	DEGRADATION (%) - - CAPABILITY (%)
1. Analysis of Capability of Alternate Div-86 155-MM Howitzer Battery Organizations JULY 82	Artillery Battery (Div-86) 155-MM	129	114	8	34.6%	10 - 96 20 - 82 30 - 65
2. Design of a BN. Combined Arms Task Force (BCATF) APRIL 1983	Tank Company	62	54	12	26.8%	15 - 83 30 - 75 40 - 66
	Mech. Inf. Co.	135	130	12	26.6%	15 - 83 30 - 75 40 - 66
	Scout & Mortar PLT.	74	63	6	33.4%	15 - 83 30 - 66 40 - 66
3. Analysis of Capabilities of HHCs, Light Division FEBRUARY 84	HHC BDE	102	55	6	14.6%	10 - 98 20 - 98 30 - 79
	HHC DIV.	211	117	6	5.1%	10 - 99 20 - 94 30 - 66 40 - 60
4. Analysis of Proposed Personnel and Equipment for the Remotely Piloted Vehicle JUNE 84	RPV Platoon	85	65	6	51.8%	11.5 - 90 23 - 75 40 - 52
5. Analysis of the Combined Arms BN (9th ID) (HTLD) AUGUST 84	Light Motorized Inf. Co.	123	118	9	26.4%	11 - 89 22 - 79 33 - 62
	Assault Gun Co.	62	61	12	34.6%	8.3 - 87 16.6 - 77 25 - 69 33.3 - 62
	CSC	83	75	8	10.8%	16.7 - 71 25 - 66 33.3 - 41

Table 5-1. DATA FROM PAST AMORE ANALYSES
(Continued)

STUDY AND DATE	UNIT	RESOURCES (PERS) AUTH	RESOURCES (PERS) REQ	# METS FORMED	SUBSTITUTABILITY RATIO	DEGRADATION (%) - - CAPABILITY (%)
5. continued	HHC	185	167	5	3.8%	10 - 63 20 - 41 30 - 32 40 - 20
6. Analysis of the Forward Support BN (9th ID) (HTLD) AUGUST 84	HQ & SPT CO.	117	116	3	4.1%	10 - 71 20 - 52 30 - 26 40 - 4
	Mainte-nance Co.	140	140	3	2.7%	10 - 75 20 - 53 30 - 23 40 - 6
	Medical Co.	73	73	3	7.6%	10 - 79 20 - 71 30 - 59 40 - 54
7. Analysis of the Light Attack BN (9th ID) (HTLD) AUGUST 84	Light Attack Co.	62	59	9	22.9%	11 - 83 22 - 79 33 - 69
	CSC	83	75	8	10.8%	16.7 - 71 25 - 66 33.3 - 41

Table 5-2. SUMMARY OF SUBSTITUTABILITY VERSUS CAPABILITY
(Measured as Average Change from Objective Line)

UNIT TYPE	Substitutability Ratio	% DEGRADATION												Total Change From Objective Line	Average Change
		8.7	10	11.5	15	16.6	20	22	23	25	30	33	40		
1. ARTY BTRY (155 SP)	34.6		96/6				82/2				65/-5			3	1
2. TANK CO.	26.8				83/-2						75/5		66/6	9	3
3. MECH.INF.CO.	26.6				83/-2						75/5		66/6	9	3
4. SCOUT AND MORTAR PLT	33.4				83/-2						66/-4		66/6	0	0
5. HHC, BDE	14.6		98/8				98/18				79/9		62/2	37	9.25
6. HHC, DIV	5.1		99/9				94/14				66/-4		50/-10	9	2.25
7. RPV PLT	51.8			90/1					75/-2				52/-8	-9	-3
8. LMI CO.	26.4			89/0				79/1				62/-5		-4	-1.3
9. ASLT GUN CO.	34.6	87/-5				77/-7				69/-6		62/-5		-23	-5.7
10. CSC	10.9					71/-13				66/-9		41/-26		-48	-16
11. HHC	3.8		63/-27				41/-39				32/-38		20/-40	-144	-36
12. HQ & SUPCO	4.1		71/-19				52/-28				26/-44		4/-56	-144	-36.7
13. MAINT CO.	2.7		75/-15				53/-27				23/-47		6/-54	-143	-35.8
14. MED. CO.	7.6		79/-11				71/-9				59/-11		54/-6	-37	-9.2
15. LIGHT ATTACK CO.	22.9			83/-6				79/-1				69/2		-3	-1
16. CSC	10.8					71/-13				66/-9		41/-26		-48	-16

degradations beyond 40% were discounted, mainly because of the small amount of past investigation in this region, but also because resource losses below 40% result in a unit that is generally ineffective.

5.2.3 Results

A linear regression was calculated using the data in Table 5-2, where substitutability was the independent factor (X) and average change (in percent of remaining capability) was the dependent factor (Y). A graph of the linear regression is presented in Figure 5-1. The expression of the regression is $Y = -21.133 + .618\ X$. The correlation coefficient equals .594. Thus there appears to be a fairly strong relationship between unit capability and unit substitutability.

This preliminary analysis only provides a first approximation of the relationship between substitutability and resilience or unit effectiveness. Results of the effort should be used as a general guide; more detailed analyses could be conducted for other types of units, degradation ranges, numbers of METs, and ratios of authorized to required resources.

5.3 RESULTS OF THE REVIEW OF ORGANIZATIONAL EFFECTIVENESS STUDIES

This section summarizes the results of past Organizational Effectiveness studies which used AMORE, and which focused on factors controllable by a unit commander that can increase unit substitutability. Personnel substitutability is the major area of concern since the commander has little leeway in terms of increasing the substitutability of materiel resources.

That personnel training enhances substitutability is a finding of almost every study. Cross-training of critical skills also was found to be a factor which could significantly raise a unit's level of substitutability. All forms of realistic operational training were seen as important, especially where they increase a unit's capability and individual confidence, cohesiveness, morale, and esprit. The effects of cohesiveness and fatigue on personnel incapacitation were determined in one study, and were found to be significant. Numerous historical studies (World War II and Korean War) were used to support the contention that a high level of cohesiveness increases all aspects of effectiveness, including substitutability.

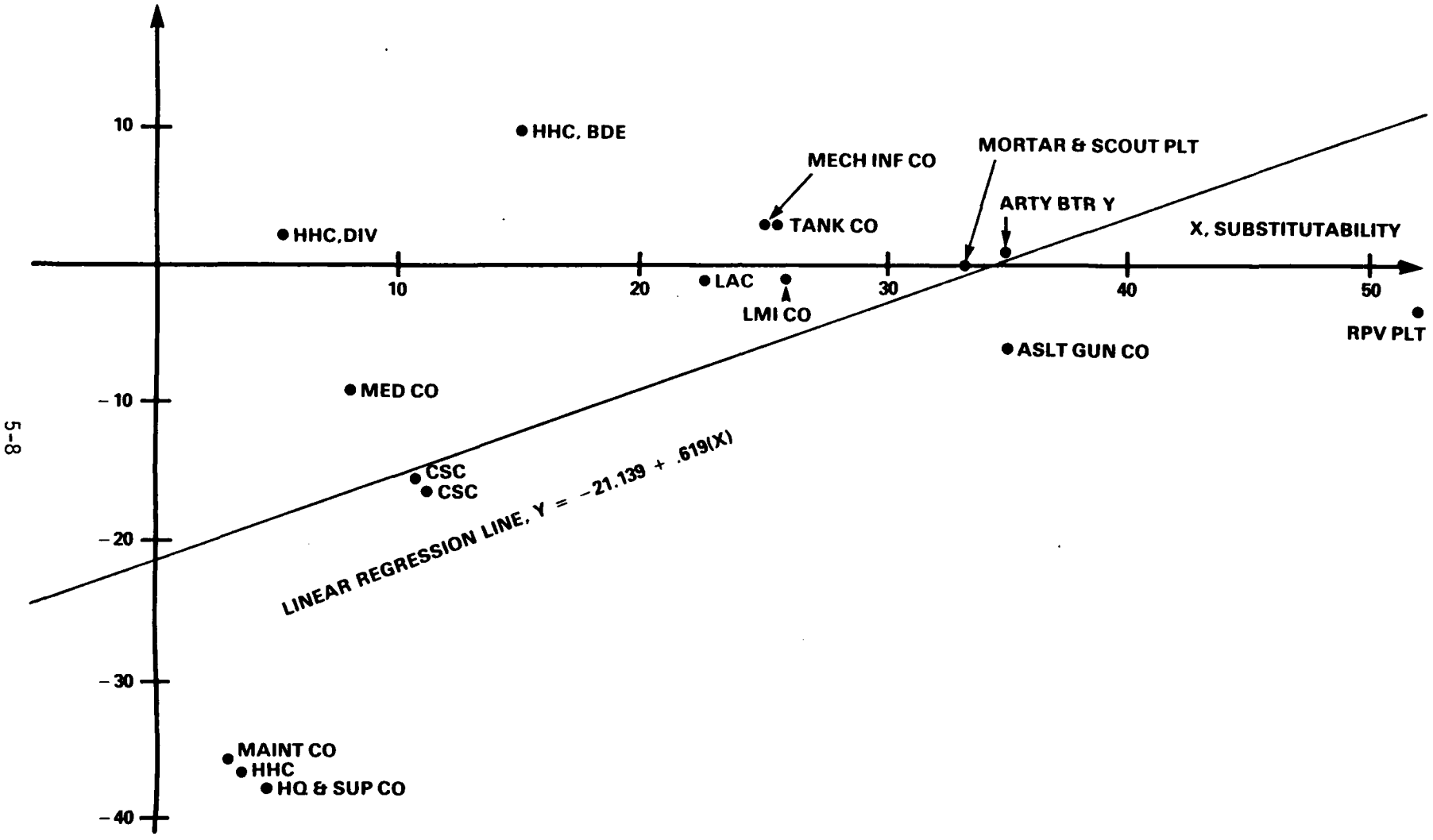

Figure 5-1. GRAPH OF LINEAR REGRESSION OF SUBSTITUTABILITY VERSUS AVERAGE CHANGE IN REMAINING CAPABILITY

Some studies pointed out that increased hardening/survivability procedures for personnel resources (such as wearing flak jackets, or preparation of hardened positions such as foxholes under static combat conditions) can provide the commander a means of increasing effectiveness by not suffering degradation. Commander's actions to reduce fatigue or battle shock (virtual losses) also help increase effectiveness. To some extent, the commander can make decisions which affect the self-sufficiency of internal organizational elements to improve effectiveness. The division of resources between war-fighting and support tasks that was described in the 155-mm Howitzer Battery study is an example of how similar resources can be used in different ways to increase overall effectiveness.

However, it was pointed out that commanders cannot rely on personal control over several factors that influence personnel substitutability. Included here are the availability of excess resources, either within the unit or as augmentation, close alignment of MOSC and grade structure authorizations within the unit, the location of resources, and materiel design changes which effect personnel substitutability. All these factors are decided at higher levels, and are not subject to the commanders discretion.

With respect to materiel, the past analyses seem consistent in indicating that the commander's greatest influence can be gained by ensuring that effective maintenance actions and procedures occur. The commander can assert influence over certain aspects of survivability within the constraints available to him, such as by the proper use of terrain and by protecting and sandbagging equipment when time permits. However, he generally has little or no direct control over excess resources or augmentation of his materiel supply, the degree of homogeneity of the materiel, or design changes to improve substitutability.

5.4 DISCUSSION

Based on the review of the pertinent Organizational Effectiveness studies which used AMORE, there appears to be four factors identified in these studies which may predict effectiveness at the NTC. These are:

- o Training/Cross Training. This is the degree to which enlisted personnel have skills training in their own and other specialties. It could be indicated by the percentage of personnel in the battalion who have passed two or more Skills Qualification Tests (SQTs).

- o Cohesiveness/Morale. This is the degree to which a unit has high esprit de corps. Several measures of this have been proposed. According to Motowidlo (1976), many military experts consider AWOL rates to be an indicator of cohesiveness/morale.

- o Physical Condition. This is the average degree of physical conditioning exhibited by all the members of a battalion. It could be indicated by the percentage of a battalion's personnel having passed their Annual Physical Training Test.

- o Equipment Maintenance. This is the degree to which a battalion maintains its equipment. It is indicated in the Unit Status and Identity Reports of a battalion and may also be another indicator of Equipment Readiness.

Several other factors were identified as influences on unit capability, but those factors (e.g., location of resources) are either not under the control of the unit, will be determined at the NTC and thus will not be able to predict effectiveness prior to performance at the NTC, or are too difficult to measure.

Section 6
CARY ET AL. STUDY

6.1 BACKGROUND

The system science related objective of this project was to identify from the Cary et al. study, variables which may be predictors of effectiveness at the NTC. This chapter describes such variables and their relationships to effectiveness.[1]

The Cary et al. study was based on Miller's living systems theory (LST) (Miller, 1978). A basic tenet of LST is that all living systems use matter, energy and information and have at least 19 subsystems whose processes are essential for system survival.

> Two of these subsystems process both matter and/or energy and information, eight process matter-energy, and nine process information. Impairment of any of these critical processes will manifest itself in systemic pathology. It seems reasonable to assume, then, analysis of these processes can result in a fuller understanding of the system, its operations, and any existing pathological conditions. It also seems likely that an increase in the performance of one or more of these subsystems (in this case the information processors) should bring about a comparable increase in the system's total condition.
>
> As LST has evolved, a limited number of direct applications of the theory have been realized over a wide range of disciplines. (See Miller, 1978, for more detailed discussion.) For example, the theory has been applied at the organism, group, and organizational

1 The review of the Carey et al. study and the refinement of its measures were conducted by Far West Laboratory and described in its report to SAIC entitled "A preliminary investigation into the application of living systems theory to the analysis of U.S. Army Combat Simulations" (Miller, et al., 1984). This chapter is based on that report and quotes from it are frequently used without reference.

levels in the social service field (Hearn, 1958). Several researchers (Bolman, 1967; Baker and O'Brien, 1971; Burgess, Nelson & Wellhouse, 1974; Pierce, 1972) have used living systems theory as a framework for modeling, analysis, and/or evaluation of community mental health activities and other health delivery systems. The theory has also been set forward as a framework for assessing program effectiveness in the areas of community life (Weiss & Rein, 1970), the study of large-scale industrial organization (Duncan 1972), the general study of organizations (Lichtman & Hunt, 1971), and the explanation of certain pathologies in organizations (Dummings & DeCotiis, 1973).

Unlike many of the other studies discussed in this report, the Cary et al. study focused on battalions in garrison rather than in field or simulated combat exercises. Thus generalizing from the Cary et al. study to effectiveness at the NTC will be very tentative and speculative.

6.2 APPROACH TO LIVING SYSTEMS ANALYSIS OF BATTALIONS IN GARRISON

6.2.1 Methodology

The Cary et al. study focused on understanding battalions in terms of the relevant and appropriate system processes contained in LST. In order to do this, 35 battalions were studied in terms of LST. The battalions were characterized in terms of LST processes and the data on processes were correlated with measures of battalion effectiveness (the study also contained many other analyses not especially relevant to effectiveness at the NTC). The review of the study resulted in the identification of nine LST systems processes as relevant to the future prediction of battalion effectiveness. These processes are described in the paragraphs below.

Input Transducer (IP) - Obtaining information from outside the battalion. This is the process of obtaining information from sources outside the battalion as it is performed in the battalion as a whole. Some examples of this type of information are ARs, Training Manuals, Reassignment Orders, Supply Bulletins, Regulations, Requisition Status Reports, Military and Civilian Course Content, and technical publications.

Internal Transducer (IT) - Internally reporting about battalion activities. This is the process of internally monitoring the battalion, that is, observing and reporting about things that go on within the battalion. Examples of this process are the development and coordination of unit training schedules and SOP's submission of SIDPERS information to the PAC by companies or individuals, and preparation of daily equipment status report (2406 backside).

Channel and Net (CN) - Relaying information within the battalion. This is the process of relaying information to others in the battalion without changing its meaning. Examples of this process include informal Face-to-Face Verbal Communications, Telephones, Distribution Centers, and Funding Guidance from the S4 to the companies.

Decoder (DE) - Making information inputs usable. This is the process of translating and clarifying information for use within the battalion. It addresses the process of putting information from outside the battalion into words that are more understandable to battalion/unit personnel, thus making the information usable within the battalion. Examples of this process are Operation Plans, Battalion Training SOP, Job Books, SIDPERS output, LES, Logistics Operations Orders and Unit Schedules.

Associater (AS) - Making recommendations for procedural changes. This is the process of using information to develop and recommend changes in battalion procedures. Examples of this process are LOSS Projections, AGI Responses, Reviews of Priorities on Class IX Requisitions and Stopping Requisitions (all classes) based on over expenditure of funds.

Memory (ME) - Storing/retrieving information within the battalion. This is the process of storing and retrieving information within the battalion. Examples of this process are the use of such things as filing cabinets, microfiche files, computer print-outs, TAFFS, Supply Documents Registers, PLL Listing, wall shelves, video tapes, and personal notebooks.

Decider (DC) - Making decisions in the battalion. This is the process of internally making decisions that control/guide/affect the battalion. Examples of this process are prioritized actions, assignments, cross-leveling of parts, cross-leveling of mechanics and selecting training methods for a specific task.

Encoder (EN) - Preparing external reports and requests. This is the process of preparing reports/requests for use outside the battalion. Examples of this process are preparing Training Highlights, briefing for Division Training Meetings, Range Support Requests, SIDPERS corrections, Personnel and Pay actions, Unit Ammunition/POL Forecast and Form 2715 (Unit Readiness Report).

Output Transducer (OT) - This is the process of sending information outside of the battalion. Examples of this process are sending Range Support Requests, training area requirements, EER/OER, Monthly Fuel Consumption Report, Monthly Mileage Report and Logistical Support Request (Class IX).

The review also revealed that only two of the systems descriptors used to characterize the processes (or subsystems) of battalions in the original study are relevant to effectiveness at the NTC. These are:

1. Process Performance. Process performance provides a set of system descriptors which seek to describe each critical information process in terms of several variables that are especially relevant in characterizing that process. Each of the nine information processes is characterized in terms of importance/usefulness, accuracy, timeliness, volume, and cost (time and effort). These variables are given common-sense definitions and rating scales as follows:

   (U) Importance/Usefulness: the extent to which information is relevant to the accomplishment of system goals.
   rating from "00-20%" (1) to "81-100%" (5)

(A) Accuracy: the extent to which information is unchanged/undistorted as it is processed.
rating from "00-20%" (1) to "81-100%" (5)

(T) Timeliness: the extent to which information is processed promptly.
rating from "00-20%" (1) to "81-100%" (5)

(V) Volume: the amount or quantity of information to be processed.
rating from "Very low" (1) to "Very high" (5)

(C) Cost: the time and effort necessary to process the information.
rating from "Very low" (1) to "Very high" (5)

Efforts to combine the five variables into a single indicator--as represented by the Process Performance Index (PPI) used in some of the LSPA, for example--may therefore be misleading. The PPI (Merker and Ruscoe, 1981; Peter and Ruscoe, 1981) was defined for information processes as follows:

$$PPI = \frac{\text{Usefulness + Accuracy + Timeliness}}{\text{Cost/Volume}}$$

The formula was an attempt to develop a single indicator of performance which reflected both the linear nature of the usefulness, accuracy, and timeliness measures and the curvilinear nature of the volume and cost measures. Unfortunately, the composite does not necessarily work.

For example, if volume and cost are both rated about the same, the cost/volume becomes unity, and the PPI reflects only the measures contained in the numerator. This result in effect ignores two of the five process performance measures. If the volume is rated high and cost low, the denominator becomes a major part of the PI, giving the false impression

that performance is very high when, in fact, an information overload may be occurring. In contrast, if volume is related low and cost high, the denominator becomes very large, thereby reducing the PPI. Although this case is not as misleading as the one in which volume is high, it still overrepresents one variable--cost--at the expense of the other measures.

2. Process Time. Process time represents a second perspective used to examine the state of the system. Process time was collected in the Job Description (JD) section of the LSPA instruments. Process time provides a set of system descriptors which seek to describe each critical process in terms of the amount of time actually devoted to that process. Whereas process performance data reflect respondents' perceptions of the battalion as a whole or at least parts of the battalion, process time data reflect the amount of time which each respondent allocates to the various LST processes within his/her own job. Battalion-wide process time can be calculated by averaging individuals' times. These averages can be calculated for the whole battalion, for areas of specialization within the battalion, or for smaller portions of these areas--e.g., the S-3 Section.

6.3 RESULTS

Battalion effectiveness was measured by a ranking entitled BER (Battalion Effectiveness Ranking) which is a composite of several traditional in-garrison measures of readiness and effectiveness including command indicators (e.g., adverse personnel actions), performance indicators (e.g., percentage of required equipment ready) and unit personnel's perceptions of unit effectiveness. BER was correlated with the process performance and time measures of the nine LST processes. The correlations found significant are shown in Table 6-1.

Since there are many significant correlations in Table 6-1, multiple regression was used to determine the set of process variables which accounted for most of the variance of BER. Before the regression analysis was performed, the BERs were transformed into ratings. "This was done by

Table 6-1. CORRELATIONS BETWEEN EFFECTIVENESS[1] AND PROCESSES[2]

For Process Performance Indications

IP-Timeliness	AS-Accuracy
IT-Usefulness	AS-Timeliness
IT-Accuracy	ME-Usefulness
IT-Timeliness	ME-Accuracy
IT-Volume	ME-Timeliness
IT-Cost	ME-Volume
CN-Usefulness	DC-Usefulness
CN-Accuracy	DC-Accuracy
CN-Timeliness	DC-Timeliness
CN-Volume	DC-Volume
CN-Cost	EN-Accuracy
DE-Usefulness	EN-Timeliness
DE-Accuracy	OT-Usefulness
DE-Timeliness	OT-Accuracy
DE-Volume	OT-Timeliness

For the Process Performance Index

CN-PPI	DC-PPI
DE-PPI	EN-PPI
ME-PPI	OT-PPI

For Process Time

AS-TIME
DC-TIME

1 Effectiveness is the Battalion Effectiveness Ranking (BER)

2 N = 35 for all correlations, and all have probabilities of .001

reanalyzing the traditional performance, command climate, and component effectiveness perception data; standardizing where necessary, and recombining the scores (using the appropriate DCSPER weightings) into a rating score which not only revealed the effectiveness rank of a particular battalion but also its relative distance from the two units closest in rank to it (i.e., above and below)." Multiple correlation was then possible as were other statistical methods. Regression was performed to determine the amount of variance in the BER accounted for by a combination of process performance variables. This approach would thereby identify the set of process variables most significantly influencing the variability in battalion effectiveness measured by the BER. The results of that preliminary regression are as follows:

Process Variable	Multiple R	R Square
ME-Timeliness	0.79874	0.63799
IT-Accuracy	0.87716	0.76941
AS-Timeliness	0.98348	0.96723

Thus the combination of these three variables accounted for 96 percent of the variance in BER scores.

6.4 DISCUSSION

The correlations in Table 6-1 show that many LST process variables are related to BER. However, most of these variables appear to be redundant in terms of accounting for variance in BER scores. Moreover, the three LST process variables identified in the multivariate regression account for most of the variance in BER scores and thus obviate the need to rely on any of the other measures as predictors of BER scores.

Based on these analyses it appears as though the timeliness of the memory process, the accuracy of the internal transducing process, and the timeliness of the associator process might be predictive of battalion effectiveness. Furthermore, it might be useful to determine if these variables are predictive of effectiveness at the NTC.

However, the Cary et al. study's measure of battalion effectiveness was a measure of "effectiveness" in garrison, not in combat-like situations. In addition, the LST process variables were indicators or predictors of the in-garrison effectiveness, and thus a second step removed from effectiveness at the NTC. Moreover, all these variables were measured by questionnaires administered to battalion personnel--a most labor intensive and logistically difficult endeavor. Given all these qualifications, the three variables presented below are tentatively suggested as those from the system science area which should be considered in conjunction with those from the other three research areas.

- o Memory Timeliness. The timeliness with which information is stored or retrieved within the battalion.

- o Internal Transducer Accuracy. The accuracy of internal reporting about battalion activities.

- o Associator Timeliness. The timelines with which recommendations are made for procedural changes.

Section 7
INTEGRATION AND DISCUSSION

The purpose of this chapter is to summarize and integrate the results of the previous chapters. In addition, the potential predictors will be rated in terms of the empirical support from the literature which links them to combat effectiveness at the NTC. Finally, the predictors will be individually related to the most appropriate specific elements of the suggested definition of effectiveness which was proposed in Section 2. The reason for linking the potential predictors to specific elements is to further substantiate their link to effectiveness at the NTC and to point out specific hypothetical relationships which would require validation.

7.1 SUMMARIZATION AND INTEGRATION OF POTENTIAL PREDICTORS

As a result of a detailed review and selected re-analysis of the four groups of studies/data bases, several variables have been identified which have the potential to be valid predictors of battalion effectiveness. The variables are presented below along with their operational definitions and are integrated into a rudimentary prediction approach in Section 7.3.

7.1.1 Command Climate Variables

Based on our in depth examination of the Command Climate Data and Studies, seven variables were suggested as potential predictors of effectiveness at the NTC. They include:

NCOs' Judgements of Effectiveness. These judgements are the averages of three ratings made by the NCOs in a battalion. The ratings were made on three scales related to the overall effectiveness of the battalion, the battalion compared to battalions previously assigned to, and how many improvements the battalion requires.

Junior Officers' Judgements of Effectiveness. These are the same as for the NCOs.

Brigade Commanders' Judgements of Effectiveness. These are composites of ratings and rankings by brigade commanders of the overall effectiveness of battalions in their command. The ratings were made on 13 point scales. The rankings were of all the battalions in their command in terms of their effectiveness.

ARTEP. This is the percentage of the measures/tasks rated satisfactory by a battalion commander during his battalion's most recent field training exercise. The ARTEP allows for field training in all the functional areas of a battalion.

AGI. This is the percentage of areas rated satisfactory during a battalion's last annual general inspection.

Equipment Readiness. This is a readiness condition reported by battalions in their monthly Unit Status and Identity Reports. It is the percentage of equipment on hand that is functional.

AWOL. This is the percentage of a battalion's enlisted personnel who were involved in unexcused absences during a given month.

7.1.2 Command Group Behavior Variables

A detailed review and examination of the Command Group Behavior Studies has resulted in seven variables which are thought to have potential as valid predictors of battalion performance at the NTC. These variables are listed and defined below.

Information Seeking. The time (or proportion of communications) spent actively gathering information.

Communication Efficiency. The ability to transmit required information in brief and explicit terms.

Communication Accuracy. The ability to transmit information without errors or omissions.

Completed Communications. The proportion of communications that actually arrive at their intended destination.

Communication Timeliness. The proportions of communications received in time to achieve their intended purpose.

Information Dissemination. The extent to which information is distributed to all personnel who may be able to use it.

Decisionmaking Quality. The ability of command staff to rapidly make appropriate command decisions.

7.1.3 Organizational Effectiveness Variables

Our re-examination of several Organizational Effectiveness Studies yielded four variables which are related to the construct of substitutability and thus linked to the resiliency aspect of effectiveness. These variables are listed below and defined in regard to their potential as valid predictors of performance at the NTC.

Training/Cross Training. This is the degree to which enlisted personnel have skills in their own and other specialties.

Cohesiveness/Morale. This is the degree to which a unit has high esprit de corps.

Physical Condition. This is the average degree of physical conditioning exhibited by all the members of a battalion.

Equipment Maintenance. This is the degree to which a battalion maintains its equipment.

7.1.4 Cary et al. Variables

The review of the Cary et al. study indicated that of the many variables which were related to or measure battalion effectiveness in-garrison, three of the variables accounted for 96 percent of the variance of the in-garrison effectiveness measure. The three variables were:

Memory Timeliness. This is the timeliness with which information is stored or retrieved within a battalion.

Internal Transducer Accuracy. This is the accuracy with which the internal reporting about battalion activities occurs.

Associator Timeliness. This is the timeliness with which recommendations for procedural changes are made within a battalion.

7.1.5 Summary

Of the 21 variables considered as potential predictors, four variables are conceptually redundant - Cohesiveness/Morale and AWOL, Equipment Maintenance and Equipment Readiness, Memory Timeliness and Communication Timeliness, and Internal Transducer Accuracy and Communication Accuracy. Because AWOL and Equipment Readiness are the accepted terms at battalion level and conceptually redundant with the other two variables, Cohesiveness/Morale and Equipment Maintenance will be dropped from the group. Memory Timeliness and Internal Transducer Accuracy will also be dropped from the group because they are redundant and more difficult to measure than Communication Timeliness and Communication Accuracy. This leaves a total of 17 variables which are suggested as potentially valid predictors of performance at the NTC on the basis of careful re-examination of the data from which they are derived.

7.2 RELATIVE DEGREES OF SUPPORT FOR PREDICTORS

7.2.1 Between Groups of Studies

All of the suggested potential predictors were selected on the basis of an in-depth review of relevant research. However, some of the studies comprising that research were more generalizable to the NTC than were others, and thus some of the suggested potential predictors have more credible support linking them to the NTC than do others. This section is designed to identify the potential predictors with the most credible support linking them to the possible prediction of effectiveness at the NTC.

Each of the four groups of studies was based on a different research model. All but the Organizational Effectiveness Studies were empirical. The latter relied on sets of arbitrarily created data for independent variables (e.g., estimates of the effect of cohesiveness on substitutability) whose effects on capability were determined from a model.

Although none of the studies related potential predictors to effectiveness at the NTC, the Command Group Behavior Studies did use the outcomes of battalion command groups engaged in combat simulations as measures of effectiveness. This dependent variable appears to have more in common with the effectiveness of battalions at the NTC than do the dependent measures used in the other groups of studies. The dependent measures focused on in the Cary et al. study were used to predict dependent measures similar to the measures of the Command Climate Studies which are being suggested as predictors of effectiveness at the NTC. Thus the potential predictors derived from the Cary et al. study are one step more removed than are those of the Command Climate Studies.

If the basic approaches of the four groups of research efforts are considered relative to the concept of predicting battalion effectiveness at the NTC, it is clear that the variables derived from the Command Group Behavior Studies appear to be the most strongly supported as predictors of effectiveness at the NTC. The second most strongly supported group of variables would be those derived from the Command Climate Studies especially those based on the ratings and rankings of senior officers as to the best indicators of effectiveness. Since the variables from the Organizational Effectiveness Studies are based on arbitrarily created sets of data for independent measures and the data for the dependent measures were derived from a model, it appears the variables derived from the Cary et al. study are more strongly supported as predictors of effectiveness at the NTC than are those from the Organizational Effectiveness Studies.

7.2.2 Within Groups of Studies

Within the groups of potential predictors derived from all but the Cary et al. study, there is variability in terms of the amount of support which exists linking the variables to effectiveness at the NTC (only one

potential predictor was suggested from the Cary et al. study). The following paragraphs describe the relative amounts of support within each groups of potential predictors.

7.2.1.1 Command Climate Studies. The three equally and most strongly supported variables were NCOs', junior officers' and brigade commanders' judgements of effectiveness. These three variables were rated as better measures of effectiveness than were all but ARTEP and AGI (Kerner-Hoeg and O'Mara, 1981). However, ARTEP and AGI were not significantly correlated with any other variables including themselves whereas the three types of judgements of effectiveness were all significantly and strongly intercorrelated.

On the basis of the ratings of the appropriateness of ARTEP and AGI as measures of effectiveness, it appears they are the next two most strongly supported variables. Equipment readiness derives its support from its correlations with ARTEP, AGI and junior officers' judgements of effectiveness (O'Mara, 1981) and thus it is not as strongly supported as are ARTEP and AGI. However, since the support for AWOL is based on a spotty pattern of correlations and a ranking of 18 on the list of most appropriate measures of effectiveness (Kerner-Hoeg and O'Mara, 1981), it has less support than does equipment readiness.

7.2.1.2 Command Group Behavior Studies. Not all of seven Command Group Behavior variables received equal support in the studies reviewed. The variables that received the most support involved the quality of communications, followed by the gathering and distributing of information, while the effects of the quality of command decisionmaking received the least support.

Each of the three major Command Group Behavior Studies reviewed indicate that simply being able to keep up with the flow of communications is vital for effective command and control. The proportion of completed communications, as well as their accuracy and timeliness were the type of variables that were most reliably related to battalion command group effectiveness in all of the studies. Effective command groups keep on top of message traffic, even when the battle becomes intense. Poor battalions, on the other hand, tend to loose control when the pace of battle becomes too hectic, resulting in more errors and lost messages.

The importance of seeking and distributing information was also fairly clearly demonstrated. In the FORGE I study, which appears to be the most methodologically sound, information seeking and distributing information were found to be nearly as important as the quality of communications. Effective battalion command groups spent more of their time actively seeking out information, and distributed that information more widely. Both these variables were correlated with battalion effectiveness measures in at least one study, and the most effective command groups in all three studies were characterized by exerting more effort to gather and distribute information. While these two variables may not be quite as critical as the simple ability to accurately transmit information, they do seem to be significant predictors of battalion command group effectiveness.

Of the seven predictor variables recommended here, the quality of command decision making received the least conclusive support. Only one of the studies (FORGE I) indicated that decision making quality was related to battalion effectiveness, and in that study decision quality appears to depend largely upon the quality of the information that went into making the decision. In the two other studies decision quality was only related to subjective impressions of effectiveness, and there are some indications that these impressions are only weakly related to actual command group effectiveness. So while being able to make good decisions is important, decision making appears to be largely dependent on the quality of the information that goes into making the decision.

7.2.3.1 Organizational Effectiveness Studies. There were only two variables which were suggested and retained as predictors from the Organizational Effectiveness Studies: training/cross training and physical condition. The training/cross training variable is probably more strongly supported simply because it appeared in a number of the studies as an influence on unit capability. On the other hand, physical condition was purported as being related to capability only once.

7.3 RELATIONSHIPS TO SPECIFIC COMPONENTS OF EFFECTIVENESS

As one additional method of attempting to relate the potential predictors to effectiveness at the NTC, each potential predictor was considered in terms of the specific components of the suggested definition

of effectiveness at the NTC. The identification of relationships between the potential predictors and specific components of a definition of effectiveness, although based on analysis and therefore speculative at this time, could serve as the genesis for specific research questions for a study to validate the potential predictors.

As specific components of a definition of effectiveness the six general missions were chosen to be related to the potential predictors. Based on the tasks required to perform each mission, and the definitions of the potential predictors, possible relationships between each potential predictor and the general missions were considered. The results of these considerations are indicated in Table 7-1. The left column of the table lists the predictors, and the six general missions are listed across the top of the table in addition to a "composite" of all the missions. An X at the junction of a row and column indicates the potential predictor in that row and the mission in that column are probably good candidates for validation.

As the table shows, eight of the potential predictors are indicated to be related to the "composite" which means that the potential predictors appear to be related to all six of the general missions. Only Equipment Readiness, the information processing variables and Associator Timeliness were believed to be differentially related to some of the six general missions. As an example of some of the relationships, consider those for Information Seeking. Information seeking is suggested as being related to Plan and Control Operations. This was suggested because the controlling of operations is an iterative and corrective process obviously enhanced by seeking information about the condition of the operations. However, Maintain Operational Security, Conduct NBC Defense Operations, and Defend Against Air Attack are much more a function of following the rigorous procedures which have been specified for these types of functions, and less dependent on corrective actions or repeatedly seeking information about the changing condition of the operations. Thus these three missions were not suggested as being strongly related to Seeking Information. For similar reasons related to the changing nature of the operations, Seeking Information was suggested as being strongly related to Conduct Sustaining Operations. For example, sustaining operations include supply and resupply tasks which obviously are strongly related informational updates. In addition, Seeking Information was suggested as being strongly related to Perform

Table 7-1. POTENTIAL PREDICTOR - CRITERION RELATIONSHIPS

POTENTIAL PREDICTORS	CRITERIA: Plan & Control Operations	Maintain Op. Security	Perform Tactical Intell. Funct.	Conduct NBC Defense Ops.	Defend Against Air Attack	Conduct Sust. Operations	Composite
NCOs' Judgements of Effectiveness							X
Jr Offs Judgements of Effectiveness							X
Bde Cdrs' Judgements of Effectiveness							X
ARTEP							X
AGI							X
Equipment Readiness	X		X		X	X	
AWOL							X
Training/Cross Training							X
Physical Condition							X
Information on Seeking	X		X			X	
Communication Efficiency	X	X	X		X		
Communication Accuracy	X		X		X		
Completed Communications	X		X		X		
Communication Timeliness	X	X		X	X		
Information Dissemination	X		X		X	X	
Decision Making Quality	X			X	X	X	
Associator Timeliness		X	X			X	

Tactical Intelligence Functions because an explicit major part of intelligence functions is seeking information about the enemy.

7.4 CONSIDERATIONS FOR A VALIDATION STUDY

If the variables suggested as potential predictors are to be useful for predicting effectiveness at the NTC and thus useful for identifying the training needs of battalions, then first the variables must be shown to be valid predictors. More useful still would be to show the variables to be strongly related to specific components of effectiveness, for such specific relationships could be used to even more precisely profile a battalion's training needs.

Before an attempt at validating potential predictors is begun, considerable effort will have to be expended to further develop the potential predictors into fully operational measures. Some of the potential predictors are already in such a fully developed state. Those include the variables derived from the Command Climate Data and the Organizational Effectiveness Studies. On the other hand, most of the variables derived from the Command Group Behavior Studies will require further development.

Also before an attempt is made to validate the potential predictors, criteria of effectiveness will have to be fully developed. Many approaches to the development of criteria of effectiveness other than the one used in this report are possible. These other approaches could result in criteria other than those suggested in this report. Moreover, many criteria of effectiveness other than those suggested in this report already have been developed (e.g., those of the UTD). Thus there are or could be developed many criteria or sets of criteria of effectiveness. These criteria or sets of criteria could all be used to evaluate battalion task forces at the NTC, albeit with possibly slightly different emphases.

The predictors of effectiveness identified in this report appear to constitute two or three different groups or sets. These, and possibly other sets may be differentially related to some of the criteria or sets of criteria that could be employed at the NTC. A study of the validity of potential predictors should investigate the relationships of each potential

predictor to each criterion set, and the canonical relationships between sets of predictors and sets of criteria.

In order to use appropriate criteria of effectiveness at the NTC, it may be necessary to identify additional types of data that should be collected at the NTC and all the requisite procedures for collecting such data. In addition, in order to be used as criteria of effectiveness, many of the types of data presently collected at the NTC will have to be further developed. Finally, criteria may have to be weighted and combined in an algorithm for producing a single criterion score or figure of merit.

The actual validation of the potential predictors appears to require a focus on battalion task forces prior to and during their exercises at Ft. Irwin. The period immediately prior to the exercises, during which a task force is still in garrison, could be used to collect predictor data, which will require elaborate and precise logistics. The data collection period for the entire study should probably span two-to-three years since the NTC processes only approximately 24 battalion task forces per year. Thus to obtain a large enough sample of task forces to allow for the splitting of the sample into appropriately sized validation and cross-validation groups will require the processing of at least 60 task forces. Then, depending on the type and components of criteria to be used, scores for each criterion will have to be calculated and correlated with the predictors. Finally, some validated predictors should be developed into a system that battalions could use as check-ups to identify the training which would help make them more truly combat effective.

7.5 SUMMARY

In summary, this project identified components for a conceptual definition of effectiveness at the NTC which will require further development if they are to be used as a valid set of criterion measures. In addition to defining effectiveness, the types of data not collected at the NTC which would be required to assess "effectiveness" were identified. Four sets of studies/data bases were then reviewed in detail relative to the components for a definition of effectiveness and 17 variables were identified which may predict effectiveness at the NTC. Nine of the 17 variables

are currently and routinely collected by battalions. Before being validated, the group of 17 potential predictors should be added to from additional sources such as military experts. If validated against criteria of effectiveness at the NTC, these and possibly additional predictors could be used by a battalion to identify the types of training which would make the battalion more combat effective.

Section 8
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Appendix A

COMPONENTS FOR A DEFINITION OF EFFECTIVENESS AT THE NTC

APPENDIX A

This appendix presents in table format, the major tasks and missions that could be used to form a criterion of effectiveness at the NTC. Also shown in the table are the types of data required to assess effectiveness in terms of the mission and tasks presented. Table A-1 has a left margin in which are listed the types of data presently collected at the NTC which are the equivalent of the "DATA CONSIDERATIONS" in the middle column of the table. (Appendix B lists complete descriptions of most of the NTC data by the task to which they are related.) The middle column of the table contains the six general ARTEP missions, each one preceeded by a roman numeral. Under each general mission are listed several "TASK(s)", each preceeded by a letter. These are the major tasks of the ARTEP general missions restated (and sometimes combined) in question format. Under each task is a heading entitled "DATA CONSIDERATIONS." These are the types of data required to assess effectiveness per TASK. In the column on the right are listed the numbers of the missions and tasks of ARTEP 71-2 from which the MISSIONS, TASKS, and DATA CONSIDERATIONS in the body of the table were taken.

Table A-1. COMPONENTS FOR A DEFINITION OF EFFECTIVENESS AT THE NTC

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
	I. MISSION - Plan and Control Operations	(3-I-1)[1]
OE: 432,433,435,441[a] EI: 2,3,69[a]	A. TASK - Was a warning order issued that provided subordinate units with appropriate information?	
	DATA CONSIDERATIONS	
	1. Warning order will include:	(3-I-1-1)
	a. Earliest time of movement	
	b. Time and location where OPORD will be issued	
	2. Warning order, as appropriate, may include:	(3-I-1-2)
	a. Reorganization	
	b. Initiation of unit movement	

[1] Parenthetical numbers refer to tasks of ARTEP 71-2 from which the mission, task or data consideration were derived.

[2] EIs are "elements of information" which are either ratings or "yes/no" type notations made by OCs. See Appendix B for those listed in the column labeled NTC Data type.

[3] OEs are observable events which are either ratings or "yes/no" type notations made by OCs. See Appendix B for those listed in the column labeled NTC Data type.

[a] These NTC data types are similar to the corresponding ARTEP data types, but they may not provide sufficient information.

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
OE: 432,433,437,463 EI: 15,28,59,60,69	B. TASK - Was an adequate physical reconnaissance conducted?	
	DATA CONSIDERATIONS	
EI: 59	1. Reconnaissance can be mounted, dismounted, or aerial.	(3-I-1-3)
EI: 28,60	2. The reconnaissance should not compromise the mission, i.e. OPFOR should not detect it as such.	
OE: 1,2,3,4,5,9,11,16,17, 18,19,22,23,25,46,47, 50-53,70-73 EI: 405,406,422,432,433,434, 436,439-441,445,454,455, 457,463	C. TASK - Was an OPORD/company order issued that provided subordinate units with appropriate information?	
	DATA CONSIDERATIONS	
	1. OPORD will include:	(3-I-1-4) thru (3-I-1-11)
OE: 434[a] EI: 17[a]	a. Unit task organization	
EI: 18	b. Friendly and OPFOR situation	
EI: 5	c. Clear, concise mission statement	
OE: 405,406,439,440,445,454, 455,457 EI: 10,11,16,17,46,47,50,51, 52,53,70,71,72,73	d. Plan for maneuver and fires, missions for all organic and attached units, priorities of support for supporting units, and coordinating instructions	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSIONS/TASK
EI: 22,23,25,72 OE: 441[a]	e. Plan for reorganization and service support f. Communications-electronics operating instructions (CEOI) and commander/command post location	
OE: 405,406,410,412,434, 438,460 EI: 10,11,33	D. TASK - Did the FRAGO provide subordinate units with appropriate information?	
	DATA CONSIDERATIONS	
OE: 405,410,412,460 EI: 10[a]	1. FRAGO will include as a minimum what actions subordinate must immediately accomplish.	(3-I-1-9)
OE: 406,410,412 EI: 10	2. FRAGO, when possible, will include changes in situation, task organization, control measures, fire support plans, and service support plans.	
OE: 416,442 EI: 20,34,35,46,73 Miles Commo Message UNILOC Table * Ground Unit Position/ Location Messages	E. TASK - Was the unit able to maintain orientation?	

* NTC Data types with asterisks were taken from The Prototype National Training Center Research Data Base System's Specification developed by SAIC for ARI POM

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
	DATA CONSIDERATIONS	
Miles Commo Message UNILOC Table * Ground Unit Position/ Location Messages	1. Reported six-digit grid coordinates of unit location	(3-I-1-10)
	2. Corresponding actual six-digit grid coordinates	
	3. Compute variance and analyst variance between reported and actual location	
OE: 401,402,403,407,409, 411,420,430,431,442, 443,456,458,462 EI: 6,7,10,12,20,21,35,41, 42,47,48,50,54,56,61,66, 67,68	F. TASK - Was the control of unit movement and fire effective?	
	DATA CONSIDERATIONS	
EI: 48 Miles Commo Message Commo Table * Controller Display of Radio Transmissions Firing Summary Display	1. Did the unit accomplish the mission stated in the OPORD?	(3-I-1-12) thru (3-I-1-16)
	2. CEOI compliance	
	3. Radio transmissions less than 20 seconds	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
OE: 401,407,416,431,459,460, 461 EI: 7,10,20,21,46,49,64,66	4. Correlation of target and fire information for all classes of targets and weapons (individual, direct fire and fire support), for friendly and enemy forces.	
Firing Summary Display	a. Number of rounds fired	
Firing Summary Display	b. Number of hits on own forces	
Firing Summary Display	c. Number of hits on OPFOR	
Firing Summary Display	d. Damage (vehicle)/casualty (personnel) reports (own forces)	
Firing Summary Display	e. Damage (vehicle)/casualty (personnel) estimate (OPFOR)	
	f. Ammunition allocation/restriction/status after mission	
	II. MISSION - Maintain Operations Security (OPSEC)	(3-I-2)
OE: 426,427 EI: 7,12,13,20	A. TASK - Was an OPSEC program initiated?	
	DATA CONSIDERATIONS	(3-I-2-1)
OE: 427	1. Were countermeasure requirements determined and disseminated to the unit?	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATION	ARTEP MISSION/TASK
OE: 409,414,419,426,427 443,444,452,453[a] EI: 7,13,20,50,57,60	B. TASK - Was the OPSEC program effective?	
	DATA CONSIDERATIONS	(3-I-2-2) thru (3-I-2-14)
	1. What information was obtained by the OPFOR?	
	2. How did OPFOR gain the information	
	a. Information security	
	b. SIGSEC	
	c. COMSEC	
	d. ELSEC	
	3. Intelligence gathering activities to counter OPFOR	
	a. Known or suspected jamming	
	- Continue operations	
	- Report it	
Miles Commo Messages Commo Table * Controller Display of Radio Transmissions	b. Number of communications transmissions greater than 20 seconds	
	c. Antennas remoted	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
EI: 57,60 Archive Digitized Tape of Exercise	d. Compliance with CEOI e. Effective use of camouflage and concealment to hinder OPFOR aerial and ground surveillance f. Major items of equipment kept at least 50 meters apart	
	III. MISSION - Perform Tactical Intelligence Functions	(3-I-3)
OE: 421,428,429 EI: 8,24,29,73	A. TASK - Were prisoners of war (PW), captured documents and captured material expeditiously and correctly processed into intelligence channels?	
	DATA CONSIDERATIONS	(3-I-3-1) (3-I-3-2)
OE: 421 EI: 24,29	1. PWs should be a. Searched b. Segregated c. Silenced d. Evaluated e. Safeguarded	
	2. All captured personnel, documents and material should be tagged with the following information:	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
	a. Date and time of capture b. Six-digit coordinates of capture location c. Circumstance of capture d. Identify of capturing unit	
OE: 408 EI: 8,16,18,20,34,41,63	B. TASK - Did the unit promptly and accurately report OPFOR activity and bombing/shelling/mortar/aircraft fire?	
	DATA CONSIDERATIONS	(3-I-3-3)
EI: 20,63	1. SPOT Report on enemy activity a. Should contain size, activity, location, unit, time and equipment b. Should be dispatched to higher headquarters within 5 minutes of occurrence.	
OE: 408[a] EI: 8,16,17,18,20,41,63[a] Could be on Radio and Would be Recorded in Stream [a] EI: 20,34,63[a]	C. TASK - Did the unit promptly and accurately fire a bomb/shell/mortar/rocket/aircraft fire report?	
	1. The report should include the following elements (as appropriate for the type of fire received) (can be oral)	(3-I-3-4)

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
	a. Unit of origin b. Position of observer c. Direction d. Time from e. Time to f. Area affected (bombed, shelled, etc.) g. Number and nature of weapons/aircraft h. Nature of fire i. Number, type and caliber of weapon or round j. Flash to bang time k. Damage l. Angle of fall/descent (if croter analysis is possible) 2. Report should be submitted within 30 minutes after activity	
OE: 403 EI: 8,63 Firing Summary Report * Live fire results at NTC, O/Controller messages about air defense results (O's rate simulations)	D. TASK - Were members of the unit able to distinquish friendly vehicles and aircraft from those of the enemy? DATA CONSIDERATIONS 1. Analyze the data obtained in 3-I-1 (correlation of target and fire observation to determine how many friendly and aircraft were fired at/hit by unit personnel/weapons	(3-I-3-5) (3-I-3-6)

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
OE: 404,423,424 EI: 7,8,16,18,28,60-64	E. TASK - Was the unit able to operate observation posts without being detected by the OPFOR?	
	DATA CONSIDERATIONS	(3-I-3-7)
EI: 60	1. How many OP's were operated? 2. How many Op's were detected and properly assessed by the OPFOR?	
OE: 425 EI: 7,8,16,18,28,41,44,59, 60-65	F. TASK - Did the unit make effective use of patrolling?	
	DATA CONSIDERATIONS	(3-I-3-NA)
EI: 44	1. Did OPFOR information obtained from patrols assist in decision making?	
EI: 60	2. Did OPFOR detect patrol activities?	
	IV. MISSION - Conduct NBC Defense Operations	(3-I-4)
OE: 409 EI: 32,36	A. TASK - Was the unit prepared for operations in an NBC environment?	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
	DATA CONSIDERATIONS	(3-I-4-1) (3-I-4-2)
EI: 32[a]	1. NBC equipment distributed in accordance with unit SOP appropriate to situation a. Individual chemical protections b. M13 and M258 kits c. Dosimeters d. M11 decontamination apparatus e. M43 detection unit f. M42 alarm unit g. IM-174 radiometers h. IM/PDR-27 series radiometers	(3-I-4-7) (3-I-4-9) (3-I-4-11)
EI: 32[a]	2. Loose items, flammable/explosive items and food and water containers placed in armored vehicles or shelters.	
Archive Digitized Tape of Exercise OE: 409 EI: 32[a]	3. A 5 km separation between the unit main and alternate command posts maintained when operating in a nuclear environment. 4. Maximum use of below ground shelters, maximum dispersion of personnel, vehicles and equipment, and use of terrain for masking.	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
OE: 446,451,464 EI: 32	B. TASK - Did the unit effectively detect and respond to the NBC environment?	
	DATA CONSIDERATIONS	
	1. Analyze data on friendly casualties resulting from NBC environment.	(3-I-4-3) thru (3-I-4-6)
EI: 36	2. Analyze data on supplies and equipment to determine if expended NBC items were replaced.	(3-I-4-8) (3-I-4-10) (3-I-4-12) thru (3-I-4-17)
	3. Nuclear a. Total dose information b. Simplified fallout prediction made using M5A2 predictor c. Individuals minimize exposed skin d. When attack is predicted - Electronic devices turned off - Erected antennas disassembled	
OE: 447,449	e. Decontamination - Decon point downwind and sump dug if possible outside of containmination area - Decon accomplished by brushing, wiping, spraying and working mopping	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
OE: 448,450,464	4. Chemical a. Mission oriented protective posture (MOPP) enforced. If protective masks are not worn as part of MOPP level-personnel automatically mask upon - Any OPFOR artillery, rocket or air attack - Perceived suspicious odor, airborne droplets/mist or smoke cloud from unknown source - Overflight by OPFOR aircraft	(same as for 1-3 above)
OE: 446,451	b. Detection - M43 detection units are postioned 200-400 meters upwind (or on lead vehicle if moving) with the M42 alarm units positioned to facilitate immediate dissemination of alarm - Detection paper affixed to visible surfaces of protective clothing and equipment, munitions, etc.	
OE: 447,449	c. Decontamination - Hood, overboots, and protective gloves are decontaminated within 15 minutes after attack.	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
	d. - Partial decontamination of tactical vehicles and major weapons systems is completed within 2 hours after attack. - Coordination for complete decontamination of personnel and equipment.	
	5. Reports rendered accurately and timely a. NBC 1 Observer b. NBC 2 Evaluated data c. NBC 3 Immediate warning of expected contamination d. NBC 4 Radiation dose rate measurements e. NBC 5 Areas of contamination	(same as for 1 thru 3 above)
	V. MISSION - Defend Against Air Attack	(3-I-5)
OE: 415,452[a] EI: 13,55,56	A. TASK - Did the unit conduct passive and active air defense effectively?	
	DATA CONSIDERATIONS	(3-I-5-I)
	1. Passive defense (consider OPSEC evaluation) a. Unit occupies covered, concealed positions; activities are camouflaged	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
	b. Unit established internal air warning systems c. Unit employs air guards d. Vehicles staggered and camouflagued	
	2. Active defense	(3-I-5-2)
	a. Unit airguards detect aircraft and alert the unit immediately b. Aircraft are identified as friend or foe and by type (jet fighter; attack, troop or cargo helicopter) c. Unless under fire from the aircraft or supporting air defense engagement the aircraft - the unit holds its fire to avoid revealing its location d. If the OPFOR aircraft attacks the unit, the unit should engage the aircraft with all available weapons e. All OPFOR aircraft sightings reported.	
Miles Commo Message EI: 7,55,56[a]	B. TASK - How effective was the unit at engaging enemy aircraft?	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
	DATA CONSIDERATIONS	(3-I-5-3)
	1. Correlate target and fire information	
	a. Number of targets presented	
	b. Number of targets detected, recognized; identified	
	c. Number of targets engaged/hit	
	d. Number of rounds fired/target	
	e. Battle Damage Assessment	
	VI. MISSION - Conduct Sustaining Operations	(3-I-6)
EI: 22,23,26,27, 36-41,58 Equp. status Table Fratricide Log Display	A. TASK - Did the unit use all available resources to maintain/restore combat readiness?	
	DATA CONSIDERATIONS	(3-I-6-1) thru (3-I-6-10)
EI: 27,36,41	1. Did the unit accurately report supply, equipment, vehicle, and personnel status IAW unit SOP?	
Fratricide Log Display (if kept)	a. Actual status	
Equip. Status Table *	b. Reported status	

NTC DATA TYPE	MISSIONS, TASKS, DATA CONSIDERATIONS	ARTEP MISSION/TASK
EI: 25,30,31	2. Did the unit submit requests for necessary support and resupply in accordance with unit SOP?	
	3. Treatment and evaluation of casualties/ KIAs	
EI: 26,27	4. Reassignment of personnel	
EI: 22,23	5. Permanance of operation maintenance and emergency repairs	
EI: 31,40	6. Recovery and evaluation of damaged vehicles and equipment	
EI: 39	7. Redistribution of supplies and ammunition	
	8. Performance of field sanitary functions	

Appendix B

OBSERVABLE EVENTS AND ELEMENTS OF INFORMATION PER MISSION AND TASK

APPENDIX B

This appendix presents the observable events (OEs) and elements of information (EIs) per appropriate mission and task which were referred to in abbreviated form in Appendix A.

I. MISSION - Plan and Control Operations

A. TASK - Was a warning order issued that provided subordinate units with appropriate information?

Observable Events

No. 432 - Unit follows troop-leading procedures/commanders and staff actions? (0-9)
No. 433 - Commanders/S3 does detailed METT-T analysis? (0-9)
No. 435 - Unit issued warning order? (0,1,2)
No. 441 - Was alternate CP designated and activated if required? (0-9)

Elements of Information

No. 2 - Did plan support OPORD? (0-9)
No. 3 - COR Adhered to 1/3 - 2/3 planning time allocation. (0,1,2)
No. 69 - Was 4.2 platoon leader involved in planning process early? (0,1,2)

B. TASK - Was an adequate physical reconnaissance conducted?

Observable Events

No. 432 - Unit follows troop-leading procedures/commanders and staff actions? (0-9)
No. 433 - Commanders/S3 does detailed METT-T analysis? (0-9)
No. 437 - Was adequate recon performed prior to the development of OPORD? (0,1,2)
No. 463 - Did the commander/S3 conduct terrain analysis based upon OCOKA? (0-9)

Elements of Information

No. 15 - Did platoon reconnoiter routes within and between battle positions? (0,1,2)

No. 28 - Adequacy of Recon Activities. (0-9)
No. 59 - Were scouts employed before offensive preparation began? (0,1,2)
No. 60 - Did scout positions prevent direct OPFOR observation? (0-9)
No. 69 - Was 4.2 platoon leader involved in planning process early? (0,1,2)

C. TASK - Was an OPORD/company order issued that provided subordinate units with appropriate information?

Observable Events

No. 405 - Did commander plan for local counterattacks? (0-9)
No. 406 - Did commander plan actions in the event of reduced visibility conditions?
No. 422 - Were other avenues of approach identified and refined?
No. 432 - Unit follows troop-leading procedures/commanders and staff actions? (0-9)
No. 433 - Commanders/S3 does detailed METT-T analysis? (0-9)
No. 434 - Unit adjusts task organization based on Cdr's METT-T analysis? (0,1,2)
No. 436 - Was a written plan w/overlay produced? (0,1,2)
No. 439 - Did commander/S3 select tentative platoon BP's? (0-9)
No. 440 - Did plan established disengagement criteria? (0-9)
No. 441 - Was alternate CP designated and activated if required? (0-9)
No. 445 - Did platoons emplace protective minefields in primary BP? (0,1,2)
No. 454 - Did commander coordinate with company teams for local security? (0,1,2)
No. 455 - Did commander plan counterattack by fire? (0,1,2)
No. 457 - Did commander plan to use TOWs at standoff ranges? (0-9)
No. 463 - Did the commander/S3 conduct terrain analysis based upon OCOKA? (0-9)

Elements of Information

No. 1 - Company plan was tactically and doctrinally sound? (0-9)
No. 2 - Did plan support OPORD? (0-9)
No. 3 - COR Adhered to 1/3 - 2/3 planning time allocation. (0,1,2)
No. 4 - Was the plan adequately communicated? (0-9)
No. 5 - TF issued a complete OPORD. (0,1,2)
No. 9 - Were all key leaders at OPORD briefings? (0,1,2)
No. 10 - Was planning for the controlling/massing of fires adequate? (0,1,2)
No. 11 - Did commander have a plan for limited visibility conditions? (0,1,2)
No. 16 - Did surveillance plan meet commander's requirements? (0,1,2)
No. 17 - Were sufficient organic assets tasked to meet surveillance tasks? (0,1,2)
No. 18 - Did 3-2 articulate additional intelligence requirements to Bde? (0,1,2)
No. 19 - Did Bde provide requested information/assets to the TF? (0,1,2)
No. 22 - Was this tactical operation limited by a lack of supplies? (0,1,2)
No. 23 - Was this tactical operation limited by a lack of services? (0,1,2)
No. 25 - Was the TF plan and procedures to evacuate casualties effective? (0-9)
No. 46 - Was adequate planning conducted to integrate FA, Mortars, CAS to support Maneuver? (0-9)
No. 47 - Was FS used to reinforce obstacles? (0-9)
No. 50 - Was smoke used effectively to screen BLUEFOR movements? (0-9)
No. 51 - Did obstacle plan support commander's concept? (0,1,2)
No. 52 - Were engineer's efforts prioritized? (0,1,2)
No. 53 - Were maneuver assets used to support engineering efforts? (0,1,2)

No. 70 - Were scouts given a follow-on mission? (0,1,2)
No. 71 - Did the commander clearly communicate his concept of the operation? (0,1,2)
No. 72 - Did commander include all CA resources available? (0,1,2)
No. 73 - Did the commander adequately plan for effective maneuver against OPFOR weaknesses (i.e., flanks and rear)? (0-9)

D. TASK - Did the FRAGO provide subordinate units with appropriate information?

Observable Events

No. 405 - Did commander plan for local counterattacks? (0-9)
No. 406 - Did commander plan actions in the event of reduced visibility conditions?
No. 410 - Were disengagements coordinated? (0-9)
No. 412 - Did the commander issue clear and concise fragos? (0-9)
No. 434 - Unit adjusts task organization based on Cdr's METT-T analysis? (0,1,2)
No. 438 - Were back briefs used? (0,1,2)
No. 460 - Did unit commander reposition weapons to avoid suppression?

Elements of Information

No. 10 - Was planning for the controlling/massing of fires adequate? (0,1,2)
No. 11 - Did commander have a plan for limited visibility conditions? (0,1,2)
No. 33 - Were FRAGOs clear and concise? (0-9)

E. TASK - Was the unit able to maintain orientation?

Observable Events

No. 416 - Did the company know the positions of friendly obstacles? (0,1,2)
No. 442 - Was TOC aware of tactical situation? (0,1,2)

Elements of Information

No. 20 - Reaction to OPFOR obscuration? (0-9)
No. 34 - Was Bde kept informed of tactical situation? (0-9)
No. 35 - Did the positioning of command group facilitate command and control? (0,1,2)
No. 46 - Was adequate planning conducted to integrate FA, Mortars, CAS to support Maneuver? (0-9)
No. 73 - Did the commander adequately plan for effective maneuver against OPFOR weaknesses (i.e., flanks and rear)? (0-9)

F. TASK - Was the control of unit movement and fire effective?

Observable Events

No. 401 - Was planning adequate for controlling/massing of direct fire systems? (0-9)
No. 402 - Were weapons systems positions fitted to the terrain? (0-9)
No. 403 - Were individual fighting positions constructed for primary battle positions? (0-9)
No. 407 - Were direct fire weapons position/reposition to allow massing of fires? (0-9)
No. 409 - Was unit adequately dispersed? (0-9)
No. 411 - Did unit follow disengagement criteria? (0-9)
No. 413 - Did the commander position himself to exercise command and control for the battle? (0-9)
No. 415 - Did the company stay in its primary battle position too long? (0,1,2)

No. 416 - Did the company know the positions of friendly obstacles? (0,1,2)

No. 417 - Did the company support adjacent units by fire during disengagements? (0,1,2)

No. 418 - During the counterattack by fire, were firing positions occupied in a timely manner? (0-9)

No. 419 - During the counterattack by fire and maneuver, did the unit move over exposed routes? (0-9)

No. 420 - During the counterattack by fire and maneuver, did the unit attack against a superior force? (0-9)

No. 430 - Were adequate control measures designated? (0,1,2)

No. 431 - Were weapons positioned to cover TF sector? (0-9)

No. 442 - Was TOC aware of tactical situation? (0,1,2)

No. 443 - Was screen line far enough forward? (0,1,2)

No. 456 - Did the commander rehearse counterattack? (0,1,2)

No. 458 - Were TOWs dispersed yet mutually supporting? (0-9)

No. 459 - Did the company support company teams by fire during disengagements? (0-9)

No. 460 - Did unit commander reposition weapons to avoid suppression? (0-9)

No. 461 - Did the unit commander reposition weapons to maintain standoff? (0-9)

No. 462 - Did the commander display initiative as appropriate during the course of the operation? (0-9)

Elements of Information

No. 6 - The unit was prepared to execute mission at specified time. (0,1,2)

No. 7 - How well did Commander command/control operations? (0-9)

No. 10 - Was planning for the controlling/massing of fires adequate? (0,1,2)

No. 12 - Effective use of time to prepare primary DP. (0-9)

No. 20 - Reaction to OPFOR obscuration. (0-9)

No. 21 - How well did unit use its direct fire assets? (0-9)

No. 35 - Did the positioning of command group facilitate command and control? (0,1,2).

No. 41 - How well did unit perform BDA? (0-9)
No. 42 - How well did FSO/FI3T position themselves to support operation? (0-9)
No. 45 - Were groups and series of targets planned? (0,1,2)
No. 46 - Was adequate planning conducted to integrate FA, Mortars, CAS to support Maneuver? (0-9)
No. 47 - Was FS used to reinforce obstacles? (0-9)
No. 48 - Did FIST/FO call for counterbattery fires when appropriate? (0,1,2)
No. 49 - Did FOS/FIST/FO call for SEAD as appropriate? (0,1,2)
No. 50 - Was smoke used effectively to screen BLUEFOR movements? (0-9)
No. 54 - Were hide positions used? (0,1,2)
No. 56 - Did positions provide balance and depth? (0-9)
No. 61 - Were positions adjusted during periods of limited visibility? (0,1,2)
No. 66 - Did mortar positions support OPORD "priorities for fire"? (0,1,2)
No. 67 - Were "split" operations used? (0,1,2)
No. 68 - Were advance parties used during scheduled displacements? (0,1,2)

II. MISSION - Maintain Operations Security (OPSEC)

A. TASK - Was an OPSEC program initiated?

Observable Events

No. 426 - Was a reaction force available and used for countersurveillance tasks?
No. 427 - Did unit adequately communicate through OPFOR EW activities?

Elements of Information

No. 7 - How well did Commander command/control operations? (0-9)
No. 12 - Effective use of time to prepare primary BP. (0-9)
No. 13 - Was security established and maintained? (0,1,2)
No. 20 - Reaction to OPFOR obscuration. (0-9)

B. TASK - Was the OPSEC program effective?

Observable Events

No. 409 - Was unit adequately dispersed? (0-9)
No. 414 - Did the unit practice noise and light discipline? (0-9)
No. 419 - During the counterattack by fire and maneuver, did the unit move over exposed routes? (0-9)
No. 426 - Was a reaction force available and used for countersurveillance tasks?
No. 427 - Did unit adequately communicate through OPFOR EW activities?
No. 443 - Was screen line far enough forward? (0,1,2)
No. 444 - Were vehicle reflective surfaces covered? (0,1,2)
No. 452 - Were obvious firing positions occupied? (0-9)
No. 453 - Was there adequate dispersion within the BP?

Elements of Information

No. 7 - How well did Commander command/control operations? (0-9)
No. 13 - Was security established and maintained? (0,1,2)
No. 20 - Reaction to OPFOR obscuration. (0-9)
No. 50 - Was smoke used effectively to screen BLUEFOR movements? (0-9)
No. 57 - Did platoon make effective use of concealment? (0-9)
No. 60 - Did scout positions prevent direct OPFOR observation? (0-9)

III. MISSION - Perform Tactical Intelligence Functions

A. TASK - Were prisoners of war (PW), captured documents and captured material expeditiously and correctly processed into intelligence channels?

Observable Events

No. 421 - Were the 5 "s" for handling EPW's followed? (0,1,2)
No. 428 - Did unit attempt to obtain immediate tactical information from EPW's?
No. 429 - Were captured documents tagged?

Elements of Information

No. 8 - Did unit adequately "See the Battlefield" throughout the battle? (0-9)
No. 24 - Did unit properly process EPWs? (0-9)
No. 29 - Were wounded EPWs medically treated? (0,1,2)
No. 73 - Did the commander adequately plan for effective maneuver against OPFOR weaknesses (i.e., flanks and rear)? (0-9)

B. TASK - Did the unit promptly and accurately report OPFOR activity and bombing/shelling/mortar/aircraft fire?

Observable Events

No. 408 - Were reports accurate and timely? (0-9)

Elements of Information

No. 8 - Did unit adequately "See the Battlefield" throughout the battle? (0-9)
No. 16 - Did surveillance plan meet commander's requirements? (0,1,2)
No. 18 - Did 3-2 articulate additional intelligence requirements to Bde? (0,1,2)

No. 20 - Reaction to OPFOR obscuration? (0-9)
No. 34 - Was Bde kept informed of tactical situation? (0-9)
No. 41 - How well did unit perform BDA? (0-9)
No. 44 - Was information available from Intell sources used in developing fire plan? (0-9)
No. 63 - Did scouts report OPFOR recon activities? (0-9)

C. TASK - Did the unit promptly and accurately fire a bomb/shell/mortar/rocket/aircraft fire report?

Observable Events

No. 408 - Were reports accurate and timely? (0-9)

Elements of Information

No. 8 - Did unit adequately "See the Battlefield" throughout the battle? (0-9)
No. 16 - Did surveillance plan meet commander's requirements? (0,1,2)
No. 18 - Did Bde articulate additional intelligence requirements to Bde? (0,1,2)
No. 20 - Reaction to OPFOR obscuration? (0-9)
No. 34 - Was Bde kept informed of tactical situation? (0-9)
No. 41 - How well did unit perform BDA? (0-9)
No. 63 - Did scouts report OPFOR recon activities? (0-9)

D. TASK - Were members of the unit able to distinguish friendly vehicles and aircraft from those of the enemy?

Observable Events

No. 408 - Were reports accurate and timely? (0-9)

Elements of Information

No. 8 - Did unit adequately "See the Battlefield" throughout the battle? (0-9)
No. 63 - Did scouts report OPFOR recon activities? (0-9)

E. TASK - Was the unit able to operate observation posts without being detected by the OPFOR?

Observable Events

No. 404 - Did commander plan to use patrols and ops for local security?
No. 423 - Were radars positioned to "see the battlefield"?
No. 424 - Were GSR positioned to "see the battlefield"?

Elements of Information

No. 7 - How well did Commander command/control operations? (0-9)
No. 8 - Did unit adequately "See the Battlefield" throughout the battle? (0-9)
No. 16 - Did surveillance plan meet commander's requirements? (0,1,2)
No. 17 - Were sufficient organic assets tasked to meet surveillance tasks? (0,1,2)
No. 18 - Did 3-2 articulate additional intelligence requirements to Bde? (0,1,2)
No. 28 - Adequacy of Recon Activities. (0-9)
No. 60 - Did scout positions prevent direct OPFOR observation? (0-9)
No. 61 - Were positions adjusted during periods of limited visibility? (0,1,2)
No. 62 - Did scouts conduct OPFOR recon activities? (0-9)
No. 63 - Did scouts report OPFOR recon activities? (0-9)
No. 64 - Did scouts neutralize OPFOR recon elements? (0-9)

F. TASK - Did the unit make effective use of patrolling?

Observable Events

No. 425 - Were patrols used for surveillance?

Elements of Information

No. 7 - How well did Commander command/control operations? (0-9)
No. 8 - Did unit adequately "See the Battlefield" throughout the battle? (0-9)
No. 16 - Did surveillance plan meet commander's requirements? (0,1,2)
No. 17 - Were sufficient organic assets tasked to meet surveillance tasks? (0,1,2)
No. 18 - Did 3-2 articulate additional intelligence requirements to Bde? (0,1,2)
No. 28 - Adequacy of Recon Activities. (0-9)
No. 41 - How well did unit perform BDA? (0-9)
No. 44 - Was information available from Intell sources used in developing fire plan? (0-9)
No. 59 - Were scouts employed before offensive preparations began? (0,1,2)
No. 60 - Did scout positions prevent direct OPFOR observation? (0-9)
No. 62 - Did scouts dotcot OPFOR recon activities? (0-9)
No. 63 - Did scouts report OPFOR recon activities? (0-9)
No. 64 - Did scouts neutralize OPFOR recon elements? (0-9)
No. 65 - Did scouts recon and coordinate withdrawal routes? (0,1,2)

IV. MISSION - Conduct NBC Defense Operations

A. TASK - Was the unit prepared for operations in an NBC environment?

Observable Events

No. 409 - Was unit adequately dispersed? (0-9)

Elements of Information

No. 32 - Units ability to conduct NBC defense activities. (0-9)
No. 36 - Did supply requests reflect the units actual needs? (0,1,2)

B. TASK - Did the unit effectively detect and respond to the NBC environment?

Observable Events

No. 446 - Was there a slow reaction to chemical alarm? (0,1,2)
No. 447 - Did platoon administer proper first aid to NBC casualties? (0-9)
No. 448 - Was designated MOPP used? (0,1,2)
No. 449 - Did platoon decontaminate individuals and equipment? (0,1,2)
No. 450 - Were proper unmasking procedures followed? (0,1,2)
No. 451 - Was proper identification of agents made? (0-9)
No. 464 - Were warnings of NBC attacks properly disseminated? (0,1,2)

Elements of Information

No. 32 - Units ability to conduct NBC defense activities. (0-9)

V. MISSION - Defend Against Air Attack

A. TASK - Did the unit conduct passive and active air defense effectively?

Observable Events

No. 415 - Did the company stay in its primary battle position too long? (0,1,2)
No. 452 - Were obvious firing positions occupied? (0-9)

Elements of Information

No. 13 - Was security established and maintained? (0,1,2)
No. 55 - Did positions of ADA assets support commanders priorities? (0-9)
No. 56 - Did positions provide balance and depth? (0-9)

B. TASK - How effective was the unit at engaging enemy aircraft?

Elements of Information

No. 7 - How well did Commander command/control operations? (0-9)
No. 55 - Did positions of ADA assets support commanders priorities? (0-9)
No. 56 - Did positions provide balance and depth? (0-9)

VI. MISSION - Conduct Sustaining Operations

A. TASK - Did the unit use all available resources to maintain/restore combat readiness?

Elements of Information

No. 22 - Was this tactical operation limited by a lack of supplies? (0,1,2)

No. 23 - Was this tactical operation limited by a lack of services? (0,1,2)

No. 26 - Was the TF plans to integrate personnel replacements adequate? (0,1,2)

No. 27 - Was the Personal Daily Summary accurate? (0-9)

No. 30 - Were all KIAs evacuated? (0,1,2)

No. 36 - Did supply requests reflect the units actual needs? (0,1,2)

No. 37 - Did unit prestock class V? (0,1,2)

No. 38 - Were emergency stocks of class III maintained in combat trains? (0,1,2)

No. 39 - Did unit cross level supplies? (0,1,2)

No. 40 - Were sufficient recovery assets forward? (0,1,2)

No. 41 - How well did unit perform BDA? (0-9)

No. 58 - Were emergency stocks of class V maintained in combat trains? (0,1,2)

Appendix C

COMMAND CLIMATE QUESTIONNAIRE

APPENDIX C

The questionnaire on the following pages was used in the wave four data collection effort of the Command Climate Data Base.

COMMAND CLIMATE

VERSION I

This questionnaire is designed to learn more about the day-to-day life in your unit or section. The purpose is to allow every individual to contribute to an accurate picture of the unit.

This is not a test and there are no right or wrong answers. If the results are to be helpful, it is important that you respond to all statements as thoughtfully and frankly as possible. Your ideas are important and can provide a valuable contribution. Do not simply agree with your friends or say what you think others expect you to say.

All answers to this questionnaire are considered confidential. The completed questionnaires will be processed by computer and the results summarized in statistical form. Your individual responses will remain strictly confidential since they will be combined with those of many other people. Any background information that you list will be used to sort people into large groups and will not be used to identify you personally.

Read the instructions carefully before you begin responding to the statements. Thank you very much for your cooperation in completing this questionnaire.

DATA REQUIRED BY THE PRIVACY ACT OF 1974 *(5 U.S.C. 552a)*	
TITLE OF FORM PT 5203a(R2), Command Climate -- Version I	PRESCRIBING DIRECTIVE AR 70-1
1. AUTHORITY 10 USC Sec 4503	
2. PRINCIPAL PURPOSE(S) The data collected with the attached form are to be used for research purposes only.	
3. ROUTINE USES This is an experimental personnel data collection form developed by the U.S. Army Research Institute for the Behavioral and Social Sciences pursuant to its research mission as prescribed in AR 70-1. When identifiers (name or Social Security Number) are requested, they are to be used for administrative and statistical control purposes only. Full confidentiality of the responses will be maintained in the processing of these data.	
4. MANDATORY OR VOLUNTARY DISCLOSURE AND EFFECT ON INDIVIDUAL NOT PROVIDING INFORMATION Your participation in this research is strictly voluntary. Individuals are encouraged to provide complete and accurate information in the interests of the research, but there will be no effect on individuals for not providing all or any part of the information. This notice may be detached from the rest of the form and retained by the individual if so desired.	
FORM Privacy Act Statement 26 Sep 75	

DA Form 4368-R, 1 May 75

INSTRUCTIONS

1. This questionnaire has two parts: an answer sheet and a question booklet. The section that you are now reading is the question booklet. Check to see that you have an answer sheet.

2. Read each statement carefully.

3. As soon as you understand a statement, decide how much you agree with it. Your first impressions are more valuable than your second thoughts.

4. After you have decided on your answer, it will be recorded on the separate Answer Sheet that indicates the amount of your agreement.

5. If no answer category exactly expresses your thoughts, use the best answer available. Be sure to mark only one answer for each statement and to respond to all statements.

6. Be sure to follow the answer sheet carefully. Match the numbers on the answer sheet with the number of each statement.

7. Please use a pencil in completing this form.

8. Please do not make any marks on the Questionnaire Booklet.

DEFINITIONS

In filling out this questionnaire, please use the following definitions:

"Your supervisor" - the person who gives you your day-to-day work assignments and evaluates your work.

"Your unit" - your company/troop/battery.

"Your work group" - the group of people that you work with on a day-to-day basis.

SECTION A

In this section each question has the scale printed under it. Put your answer to these questions (numbers 1 to 6) on the answer sheets.

1. Sex

   A. Male
   B. Female

2. Marital Status

   A. Single
   B. Married, living with family
   C. Married, separated from family due to lack of affordable housing
   D. Married, separated from family due to other reasons
   E. Divorced

3. Housing

   A. On post - barracks
   B. On post - family housing
   C. On post - other
   D. Off post - government furnished housing
   E. Off post - civilian housing

4. Race/Ethnic Group

   A. Black
   B. Hispanic (Chicano, Mexican-American, Puerto Rican)
   C. Native American (American Indian, Aleut)
   D. White
   E. Other

5. Is your present salary sufficient to provide you with a decent standard of living?

   A. I can live quite comfortably within my salary.
   B. My salary is adequate to meet my needs.
   C. It is difficult to live decently with my salary.
   D. Trying to live within my salary imposes a great hardship on me and my family (if any).
   E. I can get by on my salary only by going heavily in debt.

6. What is your level of education?

   A. Less than high school
   B. High school or G.E.D. diploma
   C. Some college
   D. College degree
   E. Advanced degree

SECTION B

The following scale is used to indicate your agreement or disagreement with statements (7-79).

A	B	C	D	E
Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

7. My job gives me the chance to learn skills that are useful outside the Army.

8. In my job, I can tell how well I am doing without other people telling me.

9. I know what I will be doing from day to day.

10. My job requires high-level technical skills.

11. In my job, I have more work to do than one person can handle.

12. My job lets me use my skills and training.

13. In my job, I have to work extra hours.

14. My job lets me do the things I am good at.

15. My job keeps me too busy to take extra training programs.

16. My job gives me the feeling that I have done something important.

17. The pressures of my job spill over into my off-duty life.

18. I can see what my job has to do with others in my unit.

19. I have full responsibility for doing certain parts of my job.

20. My job leaves me feeling tired at the end of the day.

21. Army rules and regulations make it hard for me to do my job.

22. My supervisor is willing to listen to my problem.

23. My unit gets told about important events later than other units.

24. Scheduled events like training and inspections are cancelled at the last minute.

25. My supervisor encourages people to give their best efforts.

26. In my unit it is hard to get the equipment and tools I need to do my job.

SECTION B

A	B	C	D	E
Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

27. My supervisor gives me instructions that conflict with other information I get.

28. My supervisor offers new ideas for solving job-related problems.

29. The officers in my unit care about what happens to the individual soldier in my unit.

30. My supervisor maintains high standards of performance.

31. Excessive drinking is not a problem in my unit.

32. My supervisor makes us work a lot of unnecessary overtime.

33. The soldiers in my unit let you know when they think you've done a good job.

34. When I'm talking to my supervisor, he doesn't pay attention to what I'm saying.

35. My unit does not have a drug problem.

36. The soldiers in my unit try to think of better ways of getting the job done.

37. My supervisor lets other supervisors interfere with my work group.

38. My supervisor puts suggestions by the members of the unit into operation.

39. The soldiers in my unit criticize guys who are goofing off.

40. My supervisor decides what shall be done and how it shall be done.

41. My supervisor makes sure his role in the company is understood by the men.

42. The soldiers in my unit get along with each other.

43. Decisions are made in this unit after getting information from those who actually do the job.

44. My unit is respected on this post.

45. My supervisor gives us big jobs late in the day and wants them done before we leave work.

46. The senior NCOs in my unit look out for the welfare of the individual soldier in my unit.

SECTION B

A	B	C	D	E
Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

47. Meetings in this unit generally accomplish meaningful objectives.

48. Decisions are made in this unit at those levels where the most adequate information is available.

49. My supervisor insists that individuals follow standard operating procedures.

50. My supervisor lets individuals know what is expected of them.

51. My unit is willing to try new or improved methods of doing work.

52. There is discrimination against minorities in this unit.

53. I get a sense of accomplishment from the work I do.

54. Workload and time factors are taken into consideration in planning our work group assignments.

55. I look forward to coming to work every day.

56. My supervisor acts without consulting the men in the unit.

57. My job helps me to achieve my personal goals.

58. Rules in this unit are enforced.

59. There is discrimination against whites in this unit.

60. This unit places a high emphasis on accomplishing the mission.

61. I want to contribute my best efforts to the unit's mission and my assigned tasks.

62. My supervisor refuses to explain his actions.

63. The information I receive down through the chain-of-command is generally accurate.

64. My supervisor treats the people who work for him fairly.

65. I feel safe in my unit area.

66. My possessions are safe where I live.

67. All in all, I am satisfied with the unit that I am in.

SECTION B

A	B	C	D	E
Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

68. I have a good opportunity for advancement in this unit if I do a good job.

69. I am satisfied with the medical and dental care that the Army provides for me and my dependents (if any).

70. I am satisfied with my barracks living area or housing that the Army provides for me and my dependents (if any).

71. The job I have is a respected one.

72. Considering my skills and effort I put into the work, I am satisfied with my pay.

73. All in all, I am satisfied with my supervisor.

74. All in all, I am satisfied with the persons in my work group.

75. All in all, I am satisfied with the Army compared to most other organizations.

76. I enjoy doing the type of work that my job requires.

77. In general, I feel that I have gotten a fair deal from the Army.

78. All in all, I am satisfied with my job.

79. The members of my work group try to do their best.

80. I try to do my best.

81. My supervisor tries to do his best.

82. How well do you know how to do your job?

A. expert
B. above average
C. average
D. below average
E. poor

83. What is your evaluation of the overall work effectiveness of your company/troop/battery?

A. Not effective
B. Slightly effective
C. Effective
D. Very effective
E. Extremely effective

84. Compared to all other units that you have ever served in how effective is your company/troop/battery?

A----------B----------C----------D----------E

Least Effective Most Effective

85. How many improvements would it take to make this unit the most effective company/troop/battery that you have ever served in?

A. Many improvements are needed
B. Quite a few improvements are needed
C. Few improvements are needed
D. Very few improvements are needed
E. No improvements are needed

86. Which of the following best describes your career intentions at the present time?

A. I will stay in the Army until retirement
B. I will reenlist upon completion of my present obligation but am undecided about staying until retirement
C. I am undecided whether I will reenlist
D. I will probably leave the Army upon completion of my present obligation
E. I will definitely leave the Army upon completion of my present obligation

87. What type of grades did you usually get in school?

A. mostly A's
B. mostly B's
C. mostly C's
D. mostly D's
E. mostly E's

88. What percentage of the people in your unit are involved in inter-unit sport activities?

A. 0 - 20%
B. 21 - 40%
C. 41 - 60%
D. 61 - 80%
E. 81 - 100%

89. About how frequently do members of your unit take part in military ceremonies?

A. Once a year or less
B. 2 - 10 times a year
C. About once or twice a month
D. About once a week
E. More than once a week

90. How often do off-duty unit activities occur in your unit?

A. Never
B. 1 - 5 times a year
C. 6 - 10 times a year
D. Once or twice a month
E. Weekly

91. About how frequently do members of your unit take part in an inspection in ranks?

A. Once a year or less
B. 2 - 10 times a year
C. Once or twice a month
D. About once a week
E. More than once a week

92. Think of the four adults who are your best friends. (Do not include your parents, spouse, brothers or sisters.) How many of these people are in your unit?

A. None
B. 1
C. 2
D. 3
E. 4

93. Think of the four adults who are your best friends. (Do not include your parents, spouse, brothers or sisters). How many of these people are in the Army?

A. None
B. 1
C. 2
D. 3
E. 4

SECTION D

The following items deal with your willingness to deploy with your unit. Please indicate how willing you would be to deploy with the unit you are in right now to each of the described situations by choosing one of the following responses:

A. Would do almost anything to avoid going.
B. Would make an effort to avoid going.
C. Would go if required.
D. Would make an effort to go.
E. Would do almost anything to go.

94. How willingly would you deploy to a combat zone with only a small chance of actual contact with the enemy?

95. How willingly would you deploy to combat zone with a good chance of actual contact with the enemy?

96. How willingly would you enter battle against a smaller, ill-equipped enemy unit?

97. How willingly would you enter battle against a determined, well-equipped enemy unit of the same size as your unit?

98. Have you ever tried to see your company/troop/battery commander?

A. I never tried because I didn't need to.
B. I tried and was able to get to see him without any trouble.
C. I tried and was able to see him, but it was a lot of trouble.
D. I tried and could not get to see him at all.
E. Although I needed to see him, I never tried because I knew I couldn't get to see him.

99. Are you on your first term of enlistment?

A. Yes
B. No

Please indicate your agreement or disagreement to the following items by using the following response scale:

A	B	C	D	E
Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

100. I enlisted in the Army to obtain a steady job.
101. I enlisted in the Army to find out what to do with my life.
102. I enlisted in the Army to get away from money or financial problems.
103. I enlisted in the Army to travel to new places.
104. I enlisted in the Army to become eligible for veterans' benefits.
105. I enlisted in the Army to receive special training or obtain a skill.
106. I enlisted in the Army to serve my country.

107. Whites in my unit stick together.
108. Blacks in my unit stick together.

SECTION E

For the questions in this section, please use the following scale. Note that this is somewhat <u>different</u> than the scale used elsewhere.

A	B	C	D	E
To a very little extent	To a little extent	To some extent	To a great extent	To a very great extent

109. To what extent do you think our Army leaders are smart people who know what they are doing?

110. To what extent do you think Army officers try to do as good a job as they can?

111. To what extent do you think you can trust our Army leadership to do what is right?

112. To what extent are appropriate standards of order and discipline maintained within your unit?

113. To what extent do people in your unit do what the supervisor wants because they respect his authority?

114. To what extent do people in your unit do what the supervisor wants because he can give special rewards to those who cooperate with him?

115. To what extent do people in your unit do what the supervisor wants because he can punish or make things difficult for those who do not cooperate?

116. To what extent do people in your unit do what the supervisor wants because they respect his experience and good judgment?

117. To what extent do people in your unit do what the supervisor wants because they like him as a person?

118. To what extent do people in your unit do what is expected or asked of them because they feel they owe it to their unit and don't want to let the unit down?

SECTION E

For the next five questions, please indicate your agreement-disagreement according to the following scale.

A	B	C	D	E
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

119. Servicemen should obey orders without question.

120. Being firm with subordinates is the best way to insure that they will do a good job.

121. A supervisor must keep a close check on his subordinates to see that they are doing a good job.

122. Although a supervisor can be democratic with his subordinates, he must still structure their work for them.

123. Subordinates prefer to be directed rather than making their own decisions in their work.

124. Which of the following best describes your unit's relationship to other units or command levels? (i.e., units above, below, or on the same level)

A. We have little or no relationship to other units.
B. We depend upon other units for various things, but they don't depend on us.
C. Others depend upon our unit, but we don't depend upon them.
D. We depend upon other units and they depend upon us.

125. What do your exchanges with other units involve?

A. Mostly resources -- goods and material that are delivered.
B. Mostly services performed by or for us.
C. Mostly just information passed to or from our unit.

SECTION F

Use the following scale to indicate your agreement or disagreement with the statements below (126-160).

A	B	C	D	E
Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

126. This unit has a real interest in the welfare of assigned personnel.

127. Most people will <u>not</u> take advantage of you if they get the chance.

128. NCO's have an adequate chance to speak their opinion concerning reward or punishment actions involving junior enlisted soldiers who work for them.

129. In the Army there are no right or wrong ways to do things, only easy and hard ways.

130. How hard you work or how good a job you do matters more in getting ahead than luck and who you know.

131. NCO's are not given enough training to do their job right.

132. NCO's are respected by junior enlisted soldiers.

133. Most senior NCO's and officers can <u>not</u> be trusted.

134. I have enough time off to take care of my personal and family needs.

135. I feel NCO's should have the authority to give or take away passes of their subordinates.

136. I feel that I am really accomplishing something in the Army.

137. There are few dependable people any more.

138. There is a clear understanding in my unit of which duties are to be performed by NCO's and which duties are to be performed by officers.

139. NCO's in my unit know they will be backed up by the chain of command in disciplinary matters.

140. People generally receive fair treatment under the law.

141. If I were cut off from the rest of my platoon in battle, I do <u>not</u> believe that they would do everything possible to fight their way back to me.

SECTION F

Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

142. NCO's do not have enough authority of their own to handle soldier indiscipline problems.

143. There is enough emphasis on competition in this unit.

144. Most people can be trusted.

145. The Army does not eliminate undesirable NCO's.

146. NCO's are not given enough opportunity to be in charge of the training of their soldiers.

147. Most of the time it is very difficult to figure out what a person's senior NCO's and officers really want.

148. People in my work group work hard.

149. The image of the NCO corps is high.

150. There are no right or wrong ways to make money, only easy and hard ways.

151. Most senior NCO's and officers in battle would be willing to go through anything that they made their men go through.

152. I feel NCO's should have the authority to impose extra duty or restriction on their subordinates.

153. Officers fail to hold NCO's accountable when the NCO performs poorly.

154. I am working in job areas for which I have been trained.

155. People's ideas change so much that I wonder if we'll ever have anything to depend on.

156. The performance of outstanding NCO's is recognized and adequately rewarded in my unit.

157. In the Army, a person usually can depend on his senior NCO's and officers to look out for him.

158. A person has got to always first look out for "number one" (himself).

159. Officers try to take over NCO responsibilities and do them for the NCO.

160. There is a good working relationship among the personnel in this unit.

Appendix D

REVIEW OF
COMMAND CLIMATE DATA BASE STUDIES

APPENDIX D

This appendix contains a review of all available studies of ARI's Command Climate Data Base. Six papers are individually reviewed. A summarization of the results is contained in chapter three of Volume I of this report.

D.1 REVIEW OF A MODEL OF INTER-ORGANIZATIONAL INFLUENCES ON ORGANIZATIONAL PROCESSES (Bowers and Davenport, 1984)

The Bowers and Davenport paper is by far the most lengthy and complex of the six papers written about the Command Climate Data. In its several hundred pages it describes, in more detail than any of the other papers, the data collection and many subsequent analyses.

D.1.1 Description of Study

The overall purpose of the analyses of the data reported in this paper is a "look for the critical source/sources of variance in local Army unit functioning as measured by leader performance and unit effectiveness. The research question was whether the primary source/sources of inter-unit differences were to be located at the division, brigade, battalion, or company level; or were to be explained on the basis of the people who make them up." To this end, the authors and some assistants performed essentially two sets of analyses.

First Procedures. The first set of analyses performed were designed to "analyze the relative amounts of influence associated with units at various levels in the military hierarchy on command climate as perceived by individuals in the lowest level units." The first analysis of the set was a cluster analysis of the questionnaire data. The analysis was designed to determine independent indices of unit climate. Then regression analyses were performed to determine the amount of variance for each cluster that each of several demographic, unit level and functional variables could account for.

Data used for both the cluster and regression analyses were not aggregated prior to the analysis. The cluster analyses were performed separately for both wave three and four data but not wave two data. Although mention is made of the similarity of the cluster analysis results with the results of a "previous factor analysis of wave two data," no other mention of the factor analysis is made. The regression and cluster analyses were performed on the data of 4392 wave three respondents and 4623 wave four respondents. The regression analyses also were performed on the data of 4907 wave two respondents.

Results. Bowers and Davenport presented their most specific results of the cluster analyses in a single table in which are listed only the names they gave clusters and the questionnaire items which comprise each cluster. No mention is made of differences and similarities between wave three and wave four results. The clusters were given the following names:

Indices

Organizational Climate A
Organizational Climate B
Supervisory Leadership A
Supervisory Leadership B
Group Cohesiveness
Job Challenge
Motivation
Loyalty to Organization
Willingness to Deploy
Unit Effectiveness
Army/Unit Reference Group
Discipline
Standards Enforcement
Military Sentiment
Incremental Influence
Ascribed Influence
Theory X Beliefs

Single Item Indices

Assignments
Pay
Career
Standards
Authority
Unit Commitment
Unit Interrelationships
Unit Exchange

Officer Only Indices

Battalion Work Effectiveness Battalion Improvements
Battalion Effectiveness

The results of the regression analyses were presented for each cluster in the form of coefficients of partial determination. Coefficients were presented for the eight demographic variables as a group, for function, and individually for each unit level (i.e., company, division, etc.). Each coefficient was noted as being either significant or not and results were presented separately for each of the three waves of data.

The authors indicated that the results pertaining to the effects of the various levels of the unit show that the company level effects are by far the strongest and that the division also accounts for some effect. It was stated that the company level effects were significant for more than 50% of the clusters for all three waves of data.

The results pertaining to the function of the units were "seldom large." Generally, function accounted for approximately one percent of the variance of cluster scores. However, the effect of function was significant for more clusters than is the effect due to company.

Demographic variables included sex, race, educational level, marital status, grades in school, and housing type. The amount of variance due to the combined effect of all of these variables was presented and each variable was individually described as having either a significant effect or not. Results showed that educational level and race were the two most consistently significant variables across both clusters and waves.

The tables of coefficients of partial determination show that none of the effects due to any of the variables accounted for even one percent of the variance of cluster scores.

Second Procedures. The second set of analyses were performed to determine which of the authors' "models of Army unit functioning," is the most "effective." The models of Army unit functioning were actually theories or styles of management, and they were analyzed to determine which

was most predictive of the data obtained from the questionnaires. The theories initially focused on were called the "directive (traditional) management system" and the "collaborative management system." Essentially they were equivalent to McGregor's (1960) Theory X and Theory Y.

The models predictive capabilities were analyzed by comparing predictions of relationships derived from the models to the relationships found among the data. Relationships among various "constructs" (i.e. factors) of the questionnaire data were induced from the models and these relationships were compared to those based on the data which were indicated by zero-order and partial correlations between the "constructs." The derivations of the constructs were not described and the constructs are not the same as the clusters described earlier in this section. Eight hypotheses were induced from each of the models and each hypothesis was tested by approximately 15 comparisons with the various correlations.

Second Results. The results for all but one of the hypotheses were mixed; some supported the collaborative model and some supported the directive model. Because some of the tests for each of the eight hypotheses supported both of the models, neither was deemed most effective.

The next step of this set of analyses involved the estimation of two structural equation models of Army unit functioning. The components of the models were the constructs used in the previous step of the analysis. The two models were compared to the zero-order and partial correlations between the constructs to determine the "best fitting" of the two.

The results of the comparisons showed that neither of the models exhibited a good fit. The authors stated that by subsequently relying on the results of a multi-dimensional scaling of the questionnaire data, they developed a new hybrid model that was an outgrowth of the previous two models. The hybrid model was then tested and subsequently described as having accounted for 21% of the variance of "performance" scores.

The next step of the second set of analyses involved the determination of lag (i.e., x at time one with x at time two) and cross-lag (i.e., x at time one with y at time two) correlations between the constructs. One hundred and eighty-four of these were calculated to further test the valid-

ity of the hybrid model. The correlations were presented and described as generally supporting the hybrid model. In fact, most of the comparisons of the zero-order correlations between two constructs measured at the same time, with the cross-lag correlations of the same constructs, did support causal relationships similar to those of the hybrid model. However, the statistical significance of the correlations was not addressed.

D.1.2 Evaluation of Study

This evaluation does not address issues concerning the reliability and validity of the data since those issues were described earlier. Rather, this section addresses only the inferential analyses used to test hypotheses. The one overriding criticism of these analyses is that they were described in such a convoluted, overly general fashion that it is most difficult to understand them. The first set of calculations consisted of the cluster analyses and regression analyses to identify significant effects present in the questionnaire data. This approach was basically a sound way of answering the general research question posed in the stated purpose of the study. Using individual clusters instead of a single score derived from the questionnaire allowed for the determination of the specific spheres in which the effects of the independent variables were significant.

Examination of the items that make up each cluster lead one to believe that some factors were generated on a prior theoretical grounds, rather than on the basis of empirical analysis. For example, all items in the cluster labelled "organizational climate A" are positive statements about the way in which work is structured, and all items in the factor called "organizational climate B" are negative statements about work structure. In addition some items on the "A" measure appear to be exactly the opposite of some items on the "B" measure. For example, one item on the "A" measure reads, "workload and time factors are taken into consideration in planning our work group assignments", while an item on the "B" measure reads, "In my job, I have more work to do than one person can handle." Typically cluster analyses do not separate items this way since it is the magnitudes of the correlations (or similar measures) between items which are used as the criteria for determining clusters, not whether the correlations are positive or negative. It is more likely that the items which tap the same construct (such as workload demands) would have been highly intercorre-

lated and, consequently, would have been integrated parts of the same cluster. It is unclear why they were separated into different clusters. This was also the case for the two measures of supervisory leadership.

The regression analyses performed to determine the sources of influence are an acceptable means of doing so and the results of the analyses are adequately and accurately described but for a few exceptions. For example, the authors state that:

> "The coefficients of partial determination are quite small for this analysis, reflecting great individual variation within companies. This does not, however, diminish the statistical significance or meaningfulness of the differences among units, both at company and higher levels. In other words, even though a great deal of within-company variance exists, for most of the factors, company means differ significantly and meaningfully."

However, the small coefficients of determination do not reflect great individual variation within companies. They reflect the lack of shared variance between the clusters (climate variables) and the independent variables (e.g., unit level). In fact, without variation within companies, no demographic effects could possibly exist.

Secondly, the authors are implying that even though the coefficients are small, company means differ significantly and thus the effect due to company is "meaningful." Company means could differ significantly and the effect due to company be very small because company is confounded with some of the other independent variables. The fact of the matter is that the effects on the clusters due to the unit level variable of company or any other variable are extremely small and do not account for even one percent of the variance of cluster scores. Thus none of the effects due to any of the variables are meaningful.

The second set of analyses consisted of a series of model tests the purpose of which was to determine which of two models of management (directive and collaborative) were more predictive. Some of the results

show support for the final hybrid model which was developed. However, the support is very tentative and the description of the development of the hybrid model lessens one's faith in its predictive validity. For example, the multi-dimensional scaling (MDS) that was described as being performed to help produce the hybrid model is mentioned in only one sentence, and it appears to have been impossible to have generated from the command climate data the dissimilarity matrices required to do MDS.

More specific issues concerning the second set of analyses include the descriptions of the data used. To begin with, only two sentences are devoted to its description. "Measures of unit effectiveness" not obtained from the questionnaire data are stated as being used in the analyses. However, the measures are never described and tables listing the components of unit effectiveness reveal that measures labeled "effectiveness" are composed of only questionnaire data. In addition, for such a self-report measure of effectiveness, there exists the possibility that "halo effects" have contaminated the data. If this occurred for many individuals, correlations between aspects of a unit (the predictors) and unit effectiveness would be inflated, and conclusions drawn from them may be misleading. This is almost always a problem with self-report measures of effectiveness. One way to minimize halo effects is to put items concerning overall effectiveness at the end of the questionnaire. This was not done.

Also, it is never mentioned in the report how the "constructs" were derived, which are different from the earlier clusters derived from the earlier cluster analysis. In addition, the results of the model testing may be unclear because of the descriptions of some of the constructs. One example of this concerns the effects of "ascribed influence" on unit effectiveness. Ascribed influence was operationally defined as "the extent to which the supervisor used rewards/punishments to get people to work hard." To measure this, respondents were to report on a five-point scale the extent to which:

1. People in your unit do what the supervisor wants because he can give special rewards to those who cooperate with him

2. People in your unit do what the supervisor wants because he can punish or make things difficult for those who do not cooperate.

Examination of the wording of these questions reveals that they do not ask the extent to which a supervisor rewards/punishes, but rather, the extent to which the supervisor's use of reward/punishment is effective in achieving obedience among subordinates. The study's predictions referred to the former, while the analyses involved the latter. Attempts to show empirical relationships between this measure and unit effectiveness failed, even though, the use of this form of influence may be an important predictor of effectiveness in the Army. This same problem of translation and interpretation existed for the other two measures of supervisory style of influence, "incremental influence" and "legitimate influence."

D.2 THE MEASUREMENT OF BATTALION EFFECTIVENESS (O'Mara,1981)

D.2.1 Description of Study

The purpose of this study is stated as an attempt to determine the validity of a large number of measures commonly purported to measure a Army unit's effectiveness.

Procedures. The study focuses on the internal consistency of items within three separate groups of measures purported to assess the effectiveness of Army units. The author stated that a high correlation among items within each group would indicate they were all measuring the same thing and demonstrate the "concurrent validity" of the measures. The three groups of measures included were taken from the interview, questionnaire, and unit record data. The three groups of measures were labeled: (1) readiness measures (e.g. ARTEP, AGI and Unit Status Report measures, see Table 3-2 in Volume I), (2) command indicators (e.g. number of Article 15 violations, drug arrests, see Table 3-3 in Volume I), and, (3) personal judgements (e.g. opinions on unit effectiveness from interview data and questionnaire data).

The data were described as having been taken from assessments made on a total of 71 battalions located in USAREUR and CONUS. The sources of

data based on readiness measures or command indicators are standard sources prescribed by Army regulation and routinely used on a periodic basis. The third group of measures, personal judgements, were described as non-traditional measures created for this study. The personal judgements obtained from interviews were Division Commander's, Assistant Division Commander's and Brigade Commander's assessments of all the battalions within their command. Each of these raters gave each battalion under his command a rating based on a 13-point scale and performed an overall ranking of battalions within his purview. "The rating and the ranking were each converted to standard scores and then combined into a single battalion effectiveness score for that rater." From the questionnaire data were derived personal judgement scores of service members (SMs), NCOs and officers within each of the battalions. The scores were based on each rater's averaged response to three items on the questionnaire (answers to each question were ratings based on a 5-point scale). Scores "were then aggregated to produce an average SM, an average NCO, and an average officer estimate of battalion effectiveness for each of the battalions." The data of waves one through four were used.

Results. Results were reported in three correlational matrices--one matrix per group of measures. The mean for the group of 36 was .31, and the median .26. All but two of the correlations among Unit Status Report (USR) measures were labeled as significant and they ranged from -.10 to .86. The author concluded that those correlations indicated that all the USR measures reflect a general factor which supports high readiness reporting system (REDCON) ratings. However, AGI and ARTEP were not highly correlated and the only USR measures at least moderately correlated with ARTEP and AGI were those pertinent to the maintenance status of equipment. The author concluded that those relationships reflect "a unit's ability to make the most of what it has" as the common element among them.

For command indicators, there was only a small amount of internal consistency. The mean for the group of 55 correlations was .11, the median correlation .09, and almost all were less than .20. There were a large number of correlations which were labeled statistically significant but of little practical utility because they were so small, and many significant

correlations were due to the similarity of the measures (e.g. desertion rate and AWOL rate). The author concluded that command indicators do not reflect a singular construct.

The personal judgement measures showed the strongest interrelationships. The mean of the 15 correlations was .31, and the median was .29. However, "while individuals in more extreme echelons seem to hold widely disparate views regarding what constitutes unit effectiveness, individuals in intermediate echelons (i.e., Brigade Commanders, Battalion Officers) partially share the perspective of both those above and those below them in the chain-of-command."

Conclusions. The author of the paper's most significant concern was the lack of validity among measures of unit mission capability. Of particular concern was the low degree of correlation between "Overall REDCON" and ARTEPs or AGIs. The low degree of correlation between ARTEP and AGI was explained by the fact that ARTEP scores are strongly influenced by tactical proficiency whereas AGI scores emphasize garrison activity. With regard to command indicators, the author firmly cautioned against the use of any one of these measures as indicators of unit morale or discipline due to the lack of "concurrent validity" among the measures. The use of personal judgements as measures of unit effectiveness was strongly encouraged particularly by those in higher echelons. The author concluded that many shortcomings in the use of current measures of effectiveness can be fruitfully addressed.

D.2.2 Evaluation of Study

This paper leaves unanswered some questions pertinent to the study methodology. (However, it should be pointed out that the study is described in a paper presented at an annual meeting.) One of the unanswered questions is the sample size. Aside from the fact that 71 battalions were involved, the paper does not indicate the size of the Ns used for the correlations. An analysis of the correlation matrices reveals that identical correlational values in the same matrix are labeled as significant in one case and not significant in another, thus revealing sample size differences. More importantly, correlations noted as significant at the .01 and .05 level appear to have been deemed so partially on the basis of their Ns being approximately

400. The author of the paper has indicated in an interview that the correlations are the averages of the correlations for each wave of data and there were approximately 50 battalions per wave.

Another question concerns the differences or similarities in data of different waves. No mention is made of tests which show that the correlations for different waves do not differ significantly and thus are appropriate to average across waves. Tests done by SAIC between wave three and wave four data indicate that few of the correlations differ significantly (see Section D.4.2 in this Volume for a more complete discussion). However, SAIC was not able to test for differences between wave one and wave two correlations.

On a larger scale is the appropriateness of the methods used to examine the central issue of the paper--the validity of three groups of variables which purport to measure the same construct. The author intercorrelated the variables but only with those variables within the same group (e.g. readiness measures) and not with variables within the other two groups (e.g. command indicators and personal judgements). Such a strategy implies the three groups of variables measure three different constructs which is similar to the idea the author mentioned early in the preface of the paper (at least for readiness measures and command indicators). The preface contained no discussion of the personal judgements or the construct they may measure. However, it is possible that the readiness measures and the personal judgements measure the same construct. The intercorrelations of the variables within their respective groups did address the internal consistency of the measures within each group. However, since there were three different groups of measures all of which have been purported to measure effectiveness, intercorrelations only within the three groups and not between the groups, did not best assess the validity (construct) of the measures.

D.3 COMMANDERS' ASSESSMENT OF UNIT EFFECTIVENESS MEASURES

(Kerner-Hoeg and O'Mara, 1981)

D.3.1 Description of Study

This study examined the relative value of the readiness measures, the command indicators, and the personal judgements.

Procedures. A total of 84 field-grade officers' (48 Bn CO's, 28 Brigade CO's and 8 general officers) interview data were used. The data were: (1) ratings (from 0% to 100%) for each of 22 types of information as to "how accurate an assessment of battalion effectiveness would be if it were based on any single piece of information from the listed provided," and (2) the frequency with which interviewees selected each of the 22 types of information as a 5-measure composite providing "the most complete picture of a battalion's overall effectiveness." The types of information to be rated were the specific readiness measures, command indicators, and personal judgements.

Results. Both the rating and frequency types of data revealed that four of the 22 measures were rated significantly higher than and selected much more often than the rest. The measures are: ARTEP (72.5% accuracy rating, 75% included it in composite), Company grade officer's judgement (71.2%/52%), NCO's judgement (71.0%/64%), and AGI (66.7%/57%). The percentages of the fifth position items were 63.3% and 33%.

Conclusions. The authors of the paper concluded that the gap between the percentage for the fourth ranked measure, AGI (57%), and that of the fifth measure (33%) demonstrated the validity of the four measures if used in a composite. The authors also concluded that the commanders' responses to questions showed that they view these measures as falling into three different categories--readiness measures, personal judgements and command indicators. Whereas readiness measures and personal judgements were seen to be similar in value, command indicators had substantially less merit as indices of unit effectiveness. Recommendations were to discourage traditional use of command indicators as measures of unit effectiveness and to encourage reliance on the options of subordinates.

D.3.2 Evaluation of Study

This study is the most straight forward, well written, and useful of all those done on the Command Climate Data, especially in terms of identifying potential predictors of effectiveness for task forces in garrison and possible at the NTC. Obtaining the indications of experienced officers as to the most accurate measures of effectiveness is the first logical and sound step in establishing the validity of a set of potential predictors for the NTC. Since there is little evidence of any compromise to either the internal or external validity of the study, its results appear to hold substantial value.

Only one caution is offered which concerns the potential bias of the stimuli used in the interviews. It is obvious in the paper that the experimenters viewed the 22 measures as existing in three groups. The paper does not indicate that the measures were randomly listed in their presentation to evaluators. If they were not, a biased presentation of measures and possible experimenter bias during the 1 1/2 hour interviews could well have influenced the way that interviewees rated and selected the measures.

D.4 THE TEMPORAL DYNAMICS OF UNIT EFFECTIVENESS MEASURES

(O'Mara, Kerner-Hoeg and Balzar, 1982)

D.4.1 Description of Study

The purpose of this study was "to examine the way in which the various measures of unit effectiveness operate across time." The authors stated that if different measures do in fact measure the same construct, then values obtained by these measures over time should show similar trends.

Procedures. Measures of effectiveness from 55 battalions were used. The measures were taken from the five waves of climate data and thus sample size varied. The typical three types of data of the previous studies were used: readiness measures, command indicators and personal judgements. Again, measures reported on a monthly basis were "aggregated" (presumably averaged) into quarterly scores." There were a maximum of 13 quarters of data for all but the personal judgements for which there were only four samplings. For each variable, a correlation was computed between successive

measurements of the variable. For each variable correlations were computed for pairs of measurements up to those separated by eight quarters (although correlations for personal judgement data were computed for only the four waves yielding correlations for intervals of one, two and three waves). For example, for each variable, correlations were computed between adjacent quarters (e.g., between quarters one and two, two and three, three and four, etc.). These correlations were then averaged to get a single correlation for each variable, indicating the average correlation between measurements separated by one quarter. Then for each variable, correlations were computed between all measurements separated by two quarters (i.e., quarters one and three, two and four, etc.). These were averaged. The process was completed for intervals of up to eight quarters.

Results. All the correlations between immediately adjacent measurements were significant. They range from .206 to .761 with the average being .52. Generally the correlations between pairs of widely separated measurements were smaller than those between more adjacent pairs of measurements. However, for many of the command indicators, the correlations between widely separated measurements were not smaller than those between more adjacent pairs of measurements. Also, almost all the correlations between the command indicators are statistically significant even when the interval between measurements is as great as eight quarters.

Conclusions. The authors concluded that the differing rates of change for different variables indicated that the variables were measuring more than one underlying construct (i.e., unit effectiveness). They noted that the results and conclusion are similar to those of an earlier paper (O'Mara, 1981).

D.4.2 Evaluation of Study

Since the primary test of whether the variables measure the same underlying construct (i.e., unit effectiveness) was to be a comparison of the variables rates of change across time, the authors noted that the variables did not show the same rates of change over time and thus were measuring different underlying constructs. However, no two variables should

be expected to have 100 percent shared variance. Thus they could partially measure the same construct (e.g., have 50 percent shared variance) and yet have differing rates of change due to their unshared variance.

D.5 THE MEASUREMENT OF MORALE (Kimmel and O'Mara, 1981)

D.5.1 Description of Study

The purpose of this study was to develop a reliable and valid measure of Army unit morale. Items from the command climate questionnaire were used as the measure of morale.

Procedures. Questionnaire data were used from three of the four waves of data. A "satisfaction" score was calculated for each respondent by averaging his or her responses to four items on the questionnaire. A satisfaction score was calculated for each battalion by obtaining the average of all the battalion members' satisfaction scores. These averages were obtained for each wave of data.

An attempt was made to demonstrate that the satisfaction scores represent affective orientation toward the organization. This was done by categorizing all items on the questionnaire, other than the four satisfaction items, as either affectively positive, negative or neutral. The z-scores of the positive and negative items were separately averaged and then each respondents' affective orientation score was calculated as (Z+)-(Z-)/2. The affective orientation scores were correlated with scores from respondents' satisfaction items (not the sum of these items which was called the satisfaction score). Also, satisfaction scores were analyzed by using one-way analyses of variance (ANOVA) with battalion as the independent variable.

Results. The correlations between affective orientation and the scores on the satisfaction items were all about .40 for all three waves. The multiple correlation between affective orientation and all the satisfaction items was generally .80. The ANOVAs showed battalion to be a significant effect for all three waves of data (analyzed separately) and all three levels of personnel (analyzed separately).

Conclusions. The authors concluded that "morale can be legitimately operationalized" at the battalion level even though the measure of morale dealt with only satisfaction.

D.5.2 Evaluation of Study

The questionnaire items measured many types of constructs as the Bowers and Davenport (1984) paper demonstrated. However, most of the constructs were the same as or similar to organizational climate. Since the four satisfaction items were correlated with all of these climate-related items in the form of the affective orientation scores, it is reasonable to assume that the satisfaction items do in fact measure respondents' satisfaction. However, morale, as the authors pointed out, embodies more than just satisfaction.

Another issue is the authors questionable conclusion that morale can be operationalized at the battalion level. In other words, morale as measured by the four items significantly differs between battalions. Notwithstanding whether or not these items measure morale, satisfaction or organizational climate, an F value of 2.63, the average for the 9 ANOVAs (done for three waves by three types of personnel), indicates that the between-cell variance relative to the within-cell variance was minimal. (No mean squares or indications of amounts of variance accounted for were presented.) Thus the differences between battalions were only a small fraction of the differences between individuals within battalions. This is similar to the results of the Bowers and Davenport paper in which they stated that only company level effects and to a lesser extent the effect of division were significant influences on the questionnaire data; and even those effects accounted for less than one percent of the variance in any of the scores for clusters of questionnaire items. Thus, in the Bowers and Davenport paper, battalion level effects had no influence on the questionnaire data. The ANOVAs in this morale study indicated that battalion had a statistically significant effect, but only because the dfs used were so large, typically 52 and approximately 500 (for officers), or 1500 (for NCOs), or 3700 (form enlisted personnel). Thus, the conclusion that the few questionnaire items can be used to operationalize morale at the battalion level is not very strongly supported.

D.6 THE EFFECTS OF MANAGERIAL SUCCESSION ON ORGANIZATIONAL PERFORMANCE (Kerner-Hoeg and O'Mara, 1980)

D.6.1 Description of Study

In a review of past studies on the effects of the loss and subsequent replacement of a manager in both industrial and sport team settings, the authors observe that managerial succession generally produces a decrease in organizational performance. This study tested the hypothesis that, in the military organizational context, battalion performance will show a similar decrement in the period immediately following the change of battalion command. In addition, the authors hypothesize that as new commander's gain experience, the initial performance decrement will gradually disappear.

Procedures. The authors defined the independent variable as the number of months that a particular battalion commander had been in his position at the time battalion performance was assessed. The authors obtained data from "approximately 60 battalions located in the continental United States between May and November 1978." The dependent measures were the usual twenty-one different measures divided into three groups: readiness indicators, command indicators, and personal judgements. The authors report that they averaged each battalion's scores for each type of data "into quarterly figures to enhance reliability," and categorized each score in terms of one of the monthly intervals (total of 15) of the independent variable. The categorizations were based on the central month of the quarter for which the data was collected. The group of personal judgement measures was both interview and questionnaire data obtained from five sources in the following two different ways: (1) The Division Commander, Assistant Division Commander and Brigade Commander were interviewed and each yielded a standard score for each battalion under his direct authority. The standard score was derived from a rating of the battalions using a 13 point scale (A+ to F) plus a ranking of the battalions within his purview), (2) Battalion Officers and Battalion Non-commissioned officers (10% sample) questionnaire data was used to obtain their average score across three questions. A one-way ANOVA was used to test for an effect of managerial (commander) succession.

Results. The authors reported that the independent variable had a significant effect on only one of the 21 dependent measures. This finding was discounted as a chance occurrence.

Conclusions. The authors concluded that because of the high degree of "bureaucratization" in the Army, there are a number of significant factors which buffer a battalion's performance from the fact that its commander has changed: preponderance of rules and regulations precludes dramatic innovation in procedures; stability of an organizational goal to maintain combat readiness is not altered by the commander; rotation of the commander on a routine (18 months) basis reinforces stability because it provides a stable expectancy for change of CO, helps in planning, smoothes the transition and is not perceived as reflecting on the goodness or badness of battalion performance.

D.6.2 Evaluation of Study

The large size of the data base used in this study and the sources of the dependent measures (i.e. Unit Status Reports and soldier/officers judgements) contribute to the external validity of the study. However, the authors appear to have obscured whatever information the data may have contained about the effects of managerial succession. First of all, by averaging the monthly data into quarterly scores, the authors lost their best chance to observe an effect due to succession. The authors speculated, the effect of a change of command is most likely to be evidenced immediately after the change of command occurs. Thus by combining into one score the first, second and third months of dependent measures following a command change, the evidence for an effect got diluted.

Secondly, since "change" or "difference" scores were not used, the within-cell variances of the ANOVAs are much greater than they had to be and thus it was much more difficult to observe between-cell differences.

Thirdly, as McCleary and Hayes (1980) point out, an ANOVA does not control for the trend each battalion exhibited before the change of command occurred. This idea is similar to the reason for using "change" or "difference" scores when trying to measure change over time. However, the most powerful means of testing for the effect of a command change is through the

use of an auto-regressive-integrated-moving-average modeling process (c.f. McCleary and Hayes, 1980; Glass, Wilson and Gottman, 1975).

Appendix E

REVIEW OF ORGANIZATIONAL EFFECTIVENESS STUDIES

APPENDIX E

This appendix contains a review of all pertinent and available previously published studies of organizational effectiveness which were based on AMORE. Ten studies are reviewed following a description of the AMORE methodology.

E.1 DESCRIPTION OF AMORE

E.1.1 General

The AMORE methodology is a flexible, computer-based, analytical process designed to be used to assess the capability of a unit to perform its missions. The most fundamental use of the methodology is to examine the ability of a unit to be able to form organizational increments of capability after its original resources have been degraded. The methodology usually entails two phases: development of input data and use of computer based simulation.

E.1.2 Input Data

The development of input data requires a careful and detailed examination of missions, capabilities, Organizational and Operational (O&O) concepts and the resources provided in the appropriate Tables of Organization and Equipment (TOE's) for the unit selected for analysis. As part of the input data, and as one of the basic underpinnings of the methodology, the unit of analysis is divided into Mission Essential Teams (METs). METs are supposed to be equal increments of unit capability and are the minimum essential personnel and materiel resources required to form each increment.

Transfer matrices are then developed for both personnel and materiel. Transfer matrices define allowable substitutions between personnel (and materiel) which are often theoretically made after a unit's personnel or materiel have theoretically suffered casualties. Each personnel skill and materiel item is selected to fill its own position first and will not be selected to fill another position unless such selection would result in the unit being able to form another MET.

Other input data include the degree(s) of casualties (often called degradations) the unit will theoretically be subjected to. Personnel degradations can be considered to be due to combat losses, losses due to sickness, leave, drugs, or other reasons. Materiel degradations include combat losses and unavailability due to reliability, availability, and maintainability factors. Input data also include the commander's assessment time which is the time required for a commander to assess the situation, make his decision and issue guidance or orders about substitutions.

E.1.3 Computer Based Simulation

Once the input data are developed, AMORE software is used to stochastically apply degradations of interest to the personnel and materiel of the unit. The software then employs a transportation algorithm to most efficiently make substitutions among remaining personnel and materiel. Then the software determines the number of METs which the unit can form. Output also includes an identification of which resources prevent the organization from forming a greater number of METs. Since casualties are stochastically applied, the whole sequence of applying casualties, making substitutions and determining the number of METs which can be built is performed many times and the average number of METs which can be formed is calculated.

Under many circumstances, the ability of the unit to form METs as a function of time following degradation is also of interest, e.g., when unit productivity (work out ut for a specified time horizon) or materiel availability are of particular interest. In these cases the formation of METs as a function of time is calculated.

E.2 REVIEW OF STUDIES

In the context of the AMORE methodology, the capability of a unit can usually be increased by decreasing its mission requirements or by increasing its critical resources. Increased availability of materiel and personnel resources can be achieved in several ways such as an increase in the number of personnel authorized for a unit, or non-critical personnel and materiel can be replaced by critical personnel and materiel. Also, personnel can be cross-trained, and equipment can be modified so as to be usable

for multiple purposes. In addition, actions can be taken to increase the survivability of resources.

However, most of the changes suggested above require TOE changes and/or equipment modification and both of these require Department of the Army approval. Thus, if any changes such as those suggested above were made they would probably be made to all units which might go to the NTC and thus such changes or variables would not be predictors of effectiveness at the NTC. The principal course of action available to the commander for increasing a unit's potential capability after degradation and thus enhancing unit effectiveness is to increase the degree to which his personnel can substitute for one another. The factors which influence substitutability are identified in the reviews which follow. Table E-1 is a synopsis of the past AMORE analyses reviewed.

Table E-1. SUMMARY OF PAST AMORE ANALYSIS

Date of Study	Title of Study
Aug 79	Military Organizational Effectiveness of Forward Support Units
Aug 79	Organizational Effectiveness for Small Unit Design Analysis
Sep 79	Military Organizational Effectiveness/Readiness and Sustainability
Apr 81	Study of Sustainable Loss Rates
Jul 82	An Analysis of the Capability of Alt. Division-86 155mm Howitzer Battery Organizations
Apr 83	Design of a Battalion Combined Arms Task Force (BCATF)
Feb 84	An Analysis of the Capabilities of the HHC Inf. Div. (Light) and HHC Inf. Div. (L) Brigade
Apr 84	Application of AMORE Methodology to Manpower, Personnel, Training Front-End Analysis of New Material Systems

Table E-1. SUMMARY OF PAST AMORE ANALYSIS (continued)

Date of Study	Title of Study
Jun 84	Analysis of the Proposed Personnel and Equipment for RPV
Nov 84	Improvements of the AMORE Methodology as an Aid in the Design and Evaluation of Military Organizations

E.2.1 Military Organizational Effectiveness of Forward Support Units (Robinson, March, Murphy, and Strickland, 1979)

E.2.1.1 Description of Study

Procedures. The dual purposes of this study were to quantify the Maintenance Battalion Forward Support Company's capability after a range of casualties were applied, and to find practical ways to improve its survivability. Insights to improved capability were also developed.

The company's anatomy (structure, resources, mission priorities) was examined in detail and its missions were seen as primarily being team maintenance (provide tailored teams to service battalion types) and centralized maintenance (support the teams and provide higher echelon, centralized maintenance activities). Capability was measured as a function of the number of battalions (independently for field artillery, armor, and mechanized infantry) the company could support for each level of degradation. The following five factors were examined in terms of their cost effectiveness to increase the unit's capability after degradation: (1) damage level variation, (2) increased cross training, (3) equipment redundancy, (4) personnel hardening, and (5) materiel hardening.

Results. The analysis revealed that hardening selected items of equipment is the most cost-effective way of improving the capability of the company. Early recovery of capability was not significantly improved by increased cross training due to inability of the unit to reorganize itself and bring reassigned personnel to a level of proficiency within the time period investigated. Only personnel and equipment hardening provided significant improvement in early recovery.

The unit's ability to support battalion types, and its relative sensitivity to air versus artillery also were quantified. For the FA battalions (best support at all levels of degradation), the study found that mission capability was enhanced when decentralized teams were used to support the firing elements. The results also suggested the need for additional transportation lift and materiel handling equipment and an improved repair parts processing system, in addition to selective hardening of materiel items. Numerous critical skills were identified in the study depending on type of unit supported and level of degradation. An inexpensive improvement can be achieved by cross training automotive mechanics in critical skills, especially field artillery mechanic (45L) and instrument and fire control repairmen (41C). The electronic devices repairmen (35E) was found to be most critical at all casualty levels for Infantry Battalion support. In terms of equipment, repair parts were found to be critical at all damage levels, but the electronic shop van also became critical as severity of damage increases. This order was found to vary somewhat for artillery unit support.

E.2.1.2 Evaluation of Study

Observations that have implications for the current analysis are that AMORE techniques should be extended to determine the leverage to be gained by changes in the locations and levels of service for the various maintenance functions.

E.2.2 Organizational Development for Small Unit Design Analysis (Robinson, March, Murphy, and Strickland, 1979)

E.2.2.1 Description of Study

Procedures. This study researched the anatomy of company level units in order to identify alternative force designs to maximize capability. Findings are presented which provide insights to organizational development, and include discussion of training, organization, mission, human factors, materiel, support, and other factors that impact resiliency. Major emphasis was placed on the tank, mechanized infantry, and forward support companies, and the 155 mm SP artillery battery.

Results. Important insights resulting from this analysis include the following:

- Organizations which are designed to have a 40% or greater balanced substitutability of personnel are robust. At lower percentages of substitutability, after degradation the units are able to form fewer and unacceptable numbers of METs. A difference in substitutability (40% versus 25%) can make the difference between units that can continue to fight and those which must be replaced.

- Substitutability of materiel is generally much lower than that for personnel. For example, materiel substitutability of five to ten percent is typical. This explains why the unit effectiveness is very dependent on materiel availability and indicates the high leverage obtainable by defeating key materiel items. Due to the dominant effect of materiel losses, typical organizations can absorb approximately 30% more personnel casualties than materiel damage without further restricting the organizational capability.

- Both combat reaction and continuous combat (fatigue) induce additional casualties or virtual casualties. However, for organizations that have an adequate level (40%) of substitutability the impact of such degradation can usually be absorbed.

- o In combat environments where high levels of personnel casualties are expected (i.e., tactical nuclear or chemical) substitutability of skills should be structured at levels above 40%.

- o Preliminary investigation of the impact of the lack of cohesiveness reveals that it can degrade the organizational capability by the equivalent of 15% additional casualties. Any means to enhance unit cohesiveness is clearly of value.

- o Historically, certain organizations are more dependent on the accomplishment of a series of functions to perform their mission. Basic or primary teams in such organizations must depend on other organizational elements to be effective. A good example is an artillery battery. In other instances there are organizations which contain more self sufficient elements (e.g., tank companies). The value of self sufficiency is made evident by the AMORE analysis. Accordingly, every attempt should be made to provide self sufficiency for units to achieve maximum resiliency.

Further analyses were conducted based on the observations of past human factors studies. Each of four factors plus the added factor of damage levels were examined at two levels. These important factors are shown below, along with the change in tank unit effectiveness that resulted when each was applied.

Factor	Change in Number of Tank Crews Recovered
A - Denial of Responsibility (Fatigue)	-3.6
B - Cohesiveness	-2.4
C - Tradeoffs within Unit (6 Spaces)	+0.5
D - Unit Strength Reduction (9 Spaces)	-1.2
E - Increased Personnel Incapacitation	-2.7

The effects of fatigue (A) and cohesiveness (B) were in corporated by making adjustments to the substitutability matrix.

The relative ranking shows that the fatigue factor has about a 1/3 greater impact than the 15% increase in personnel incapacitation. The cohesiveness factor has about the same impact as the change in personnel incapacitation. Tradeoffs within the unit have a minor impact and unit strength changes have some impact. These last two factors show the type of results that can be expected when units have high degrees of substitutability among personnel.

E.2.2.2 Evaluation of Study

This study was extremely useful in providing a description of factors that effect substitutability, and providing a measure of quatification for each. A summary of factors which enhance unit capability on the battlefield was developed and are listed below:

1. High substitutability of personnel and materiel.
2. Minimum number of essential skills or materiel items per function.
3. Reduced probability of kill for both materiel and personnel.
4. Self sufficient organizational elements.
5. Appropriate levels of cohesiveness.
6. Good SOP's for training and implementation of reconstitution.

E.2.3 Military Organization Effectiveness/Readiness and Sustainability (Ross, Murphy, March, Robinson, and Tullington, September 1979)

E.2.3.1 Description of Study

Procedures. The purpose was to provide insights to improve U.S. Army unit readiness and replenishment policies by illuminating the relationships between resources and unit readiness and capability. The AMORE methodology was applied to armor, mechanized infantry, and artillery, battalions and to the Forward Support Maintenance Company to determine their capability to recover from the effects of a range of combat damage. The units were examined at three readiness levels and at full TOE capability, and were measured against four levels of combat degradation. Insights to improve readiness and replenishment policies are provided.

Periods of time following combat degradation were evaluated. The sustainability ratio was defined as the ratio of percent loss in combat capability to the percentage of lost resources. The smaller the ratio, the more sustainable the unit using its internal resources. A ratio of 1.0 or less was generally considered acceptable in past AMORE analyses.

Results. This study found that current policy (the statistical readiness categories) does not provide an accurate basis for estimating unit combat capability. Use of the AMORE methodology and the concept of the sustainability ratio was found to provide better indicators of readiness. The study also described key limiting factors. The key limiting factor for line companies was normally material, whereas personnel was usually the limiting factor for support companies.

Considerable emphasis was placed on ways to enhance personnel readiness. It was determined that considerable leverage could be achieved by prioritizing unit personnel replacements based on skills critical to sustainability and unit reconstitution. It was found that random replacement procedures, or procedures geared to strict TOE percentages ignores the criticality to combat effectiveness of certain positions.

The study also assessed the relationship of human factors to combat capability under conditions of continuous combat. The research attempted to quantify the effects of stress, fatigue, sleep loss, and "combat reaction" on individuals, and the resultant impact on organizational capability. The study found that degradation due to human factors can seriously impact combat effectiveness. The AMORE methodology was found to be able to employ appropriate human factor inputs and evaluate the resultant impacts. For example, the Service Battery of the FA Battalion was found to be able to reconstitute to about 98% of TOE personnel capability following 10% personnel casualties. But when expected "combat reaction" (for a unit experiencing combat for the first time) casualties are considered, reconstituted effectiveness drops to about 80 to 85%. These types of inputs all have major implications in terms of substitutability.

E.2.3.2 Evaluation of Study

This study established some clear relationships between degrading factors and unit sustainability. It helped to quantify the effect of factors such as morale, leadership, confidence, cohesiveness, and others on unit capability. It provided an excellent first step in establishing factors that preclude restoration of combat capability following degradation, and recommended that further study be initiated to quantify alternative means (such as cross training, redundancy, or hardening) to recover from such degradation.

E.2.4 Study of Sustainable Loss Rates (Ross, 1981)

E.2.4.1 Description of Study

Procedures. This effort investigated the response of a selected cross-section of U.S. Army unit types to losses of personnel and materiel, to determine the ability of the units to sustain operational capability levels of following degradation. AMORE was used to calculate unit capability as a function of time over a wide range of degradation levels.

Results. Capability contour charts were developed to show the maximum recovery levels that a unit could attain after sustaining particular losses of personnel and materiel. For example, after 20% loss of materiel and 17% loss in personnel, the Data Processing Unit can only recover to a 60% capability.

Figure E-1 shows differences and commonalities among units whose losses limit their maximum recovery to 60 percent. The sustainability ratio (ratio of capability loss in percent to percent loss of personnel or material) is superimposed, and shows the difference between units. A ratio of 1.0 or less has generally been used to define a robust unit. The smaller the ratio, the more inherently sustainable the unit is after degradation.

E.2.4.2 Evaluation of Study

Application of the AMORE methodology was found to enable determination of those skills, materiel items, and doctrinal and training changes

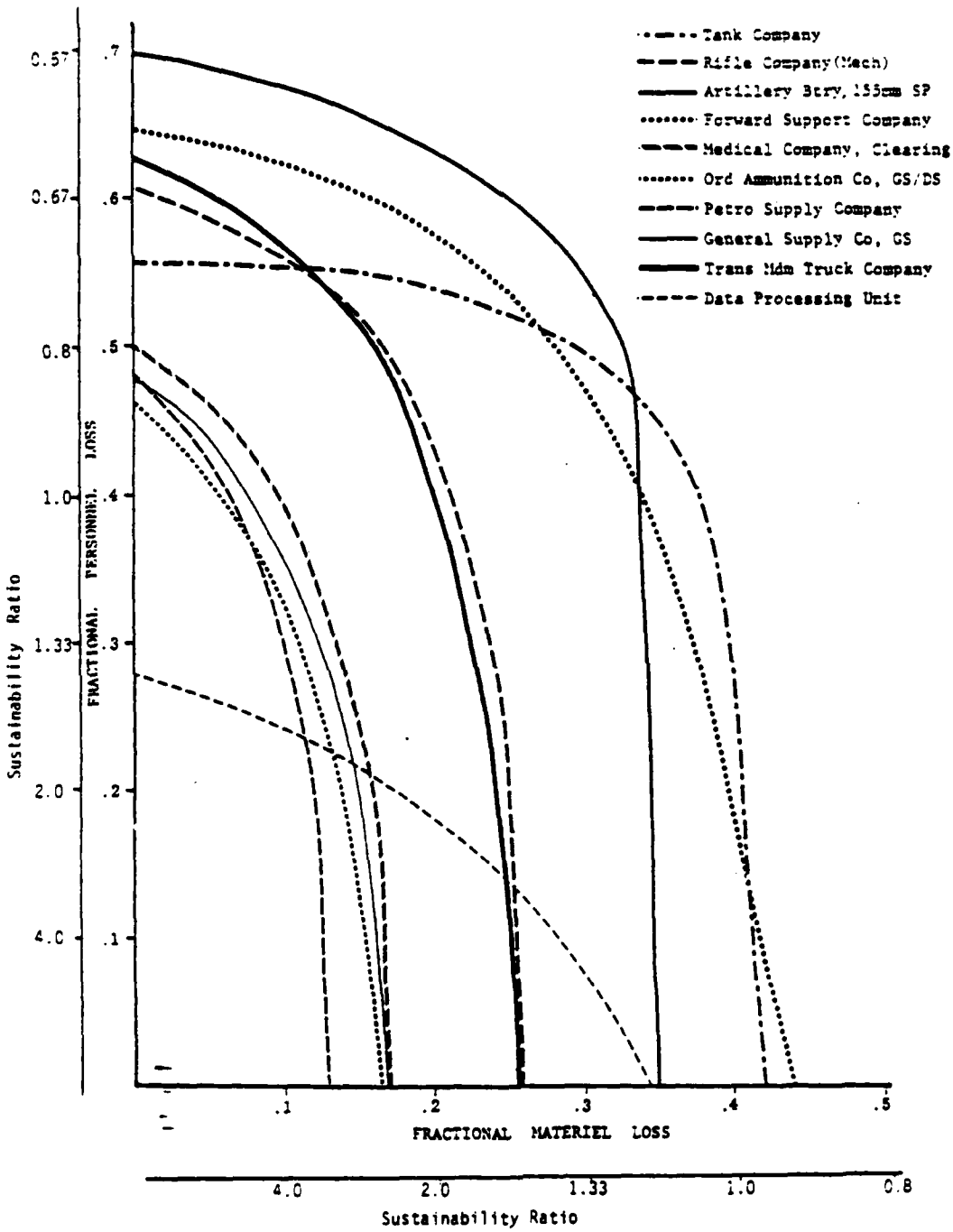

Figure E-1. COMPARISON OF UNIT RESPONSE, LOSSES LIMITING UNIT CAPABILITY RECOVERY TO 60% MAXIMUM

key to raising unit productivity. AMORE was found to have potential application in areas such as readiness, training, doctrine, system acquisition, human factors, manpower authorization criteria, force development, replenishment priorities, contingency analysis, and other cases.

E.2.5 An Analysis of the Capability of Alternative Division-86 155mm Howitzer Battery Organizations (Robinson and Hannon, 1982)

E.2.5.1 Description of Study

Procedures. A baseline and six alternative battery organizations were examined to determine the preferred alternative for a battery to accomplish high intensity continuous combat operations. METs were defined as consisting of a howitzer crew plus a slice of the command, control, and support resources needed for effective operations. The study concentrated on organization of the howitzer section (eight sections per battery). Organizational alternatives were based on the results of an ARI effort (using field measurement of task time data and use of the Crew Performance Model) that demonstrated the advantages of using two crews of five personnel each to replace the current 10-man section. The two crews would alternate between warfighting and support tasks such as replenishment of supplies, risk reduction efforts, and rest and hygiene requirements. This would permit roughly equal combat mission capability while significantly increasing the amount of time available for support tasks, and greatly reducing idle time on the part of members of the 10-man crew. Minor changes in equipment or procedures could further improve times using the new organization.

Substitutability factors for personnel were determined using past AMORE guidelines with substitution based on the 3 digit Military Occupational Specialty Code (MOSC) skill group, with time delays depending on the type and sophistication of the skill, differences in career fields, and the degree of leadership or supervisory skill and experience required. Equipment substitutability was based on the ability of one item to substitute for another, with time added depending on the type and extent of modifications required.

Results. The AMORE model substantiated that the current organization was unsatisfactory compared to that of two teams of four or five men each. It was also demonstrated by simulation that training, cohesiveness, leadership, and procedural matters can influence substitutability.

E.2.5.2 Evaluation of Study

This study provides useful insights into components of substitutability at the crew or small section level, and at the level of significant organizational interactions, and provides useful measures of the relative influence of various components of substitution.

E.2.6 Design of a Battalion Combined Arms Task Force (BCATF) (Hannon, Robinson, and Stenstrom, 1983)

E.2.6.1 Description of Study

Procedures. This study attempted to develop an organizational design methodology based on AMORE and demonstrate the methodology by using the BCATF. An alternative BCATF organization was developed which replaces two different types of organizations (armored and mechanized battalions) with two of the same type organizations (BCATF). The tank, mechanized infantry, and headquarters companies (consisting of scout and mortar platoons, combat and field trains, and command post) were separately evaluated due to their dispersed geographical locations during operations. The units were evaluated against sustained operations and two levels of surge combat conditions (15%, 30%, and 40% personnel losses, respectively). The level of substitutability was significantly higher in the tank and mechanized infantry companies than in the other BCATF elements. The tank company met or exceeded the design criteria for all three combat condition levels. As a final test, one tank platoon was detached and a mech platoon with associated support personnel was attached to determine the capability of a tank heavy company. This modification failed to meet personnel design criteria under sustained combat conditions. Additional maintenance personnel, cross training, reorganization of the MET and doctrinal changes in the employment of maintenance personnel offer potential for alleviating the shortfall. Analysis of the mech company yielded similar results and factors.

Results. Use of the AMORE methodology provided the following insights into substitutability and capability of these important combat units:

- o While personnel strength is greater than the average of the two old organizations, it can probably be reduced by further refinement, especially in the scout and mortar platoons.

- o Major factors that influence substitutability for the BCATF are its organizational concept, and the geographical dispersion of units during operations (especially in cases where a "slice" of capability is provided for each location).

E.2.6.2 Evaluation of Study

This analysis provided valuable insight into the design and the effectiveness of task-organized units and headquarters elements. The conclusions that headquarters organizations are less capable due to divided capabilities and dispersed geographical locations leads to the assessment that detailed scrutiny is required to improve the substitutability and resilience of such organizations.

E.2.7 An Analysis of the Capability of the HHC, Infantry Division (Light), and the HHC, Infantry Division (Light) Brigade (SAI, 1984)

E.2.7.1 Description of Study

Procedures. This study used AMORE to determine an optimal unit organizational structure for the headquarters companies. The study identified critical personnel skills and material items for inclusion in the optimal design.

Results. The Brigade HHC had a moderate degree of substitutability due to the variety of MOSCs normally present in a headquarters unit. Nevertheless, the unit was quite robust, due partly to the availability of numbers of personnel above MET requirements. High materiel substitutability can be attributed to the presence of many items in excess of minimum MET

requirements, and to several groups of similar equipment items (such as radios, generators, and trucks).

The Division HHC is able to build many METs even after 20 percent degradation, but after higher levels of degradation its ability to do so drops off sharply. This is due to a fairly large population of each type of personnel, and a wide range of different types of personnel. As degradation increases, skills are not available to transfer from one area to another. An exception is the G-2 function which degrades rapidly since it incorporates a wide variety of skills and disparate grade levels. It appears that cross training and combining tasks within MOSC's can significantly improve the substitutability level of the organization.

E.2.7.2 Evaluation of Study

As in other studies, it was determined that the intelligence capability of the unit (especially for division headquarters) was most sensitive to personnel losses. Cross-training in this and other sections could alleviate part of the problem. However, even cross training is not a complete solution due to variations in intelligence position grade structures and functions. Materiel substitutability for these organizations appears very positive (reliant).

E.2.8 Application of AMORE Methodology to Manpower, Personnel, and Training (MPT) Front End Analysis of New Materiel Systems (Helmuth and Conroy, 1984)

E.2.8.1 Description of Study

Procedures. The objective of this study was to develop a methodology for applying AMORE to manpower, personnel, and training front-end analysis of new materiel systems.

However, several other issues pertinent to NTC were dealt with. These began with the choice of the Division Support Weapon System (DSWS) as an illustrative example of a new materiel system in an early stage of development, and compared to its predecessor, the M109 series 155-mm self-propelled howitzer. The unit baseline was the Division-86 Howitzer Battery.

Also the effectiveness of both units was calculated using an 8 MET organization with degradation levels of 12.5, 25, and 37.5 percent. Critical personnel skills and equipment items were identified, and then new designs were developed to increase efficiency. Based on identification of critical and high-leverage skills, changes to material systems were postulated that could eliminate critical task requirements. Materiel design changes in this study included: an automatic loader, a device to remotely check firing data, and built-in maintenance diagnostic equipment. The effects of these items were reflected by making necessary changes to the unit MET and substitutability matrices. AMORE was then run to determine the influence on MET requirements.

Results. The pertinent results revealed that an increase in cross training was found to increase the percent of substitutability. On the negative side, use of new equipment items that reduce personnel requirements were sometimes found to reduce unit capability when working in degraded environments when more personnel are desired for support tasks. It was observed that the methodology can and should be used early in the development cycle of new equipment acquisitions, to include the source selection process.

E.2.8.2 Evaluation of Study

This study shows that substitutability is a critical data input for assessing unit response to degradation and shows how to quantitatively assess degradation resulting from factors such as material design changes, fatigue, and reduced levels of teamwork (provided that valid input data is developed). It also shows how equipment designed to reduce supervisory, maintenance, and communication requirements has a generally positive effect on capability, while reductions in crew size often have a minimal effect on capability, as it results in a larger starting population of personnel with non-homogeneous skills, and also reduces the number of personnel needed to perform support tasks.

E.2.9 **Analysis of the Proposed Personnel and Equipment for the Remotely Piloted Vehicle** (Hannon, Welp, and March, 1984)

E.2.9.1 Description of Study

Procedures. The purpose of this study was to use the AMORE methodology to design the Remotely Piloted Vehicle (RPV) platoon. The unit mission and Organizational and Operational (O&O) concepts were analyzed, and organizational design criteria were established, to include desired levels of capability following degradation.

Results. Substitutability criteria for personnel and materiel were discussed in detail. Platoon personnel have a high degree of substitutability, and this degree can be further increased with cross training for RPV operator/ mechanic and generator repairmen (MOS 52D). There are thirteen materiel items within the platoon for which no substitutions are possible. These items could be added to the unit authorization, but this would require additional personnel for an additional MET, or would require personnel and materiel assets for maintenance, storage, transportation and other requirements. A preferred alternative is classification of the items as maintenance float to be stocked at DS or GS level maintenance, with procedures in place for rapid accession of these items when required.

Based on the current authorization of personnel and equipment, the unit is highly capable. This is not true with regard to materiel. After about 15 percent degradation, equipment falls rapidly to about 55 percent of original capability.

E.2.9.2 Evaluation of Study

This study provides insights into the effect of changing the ordering in which METs are formed and using different ratios of type METs to enhance resiliency. Also, several factors were identified which influence substitutability. For personnel, training, especially cross training and on-the-job training, was emphasized. For materiel, the availability of replacement equipment as float items was described as a major factor. Additionally, organizational factors were discussed as having an impact on substitutability. For example, change in the percentage of type and order

of METs can help achieve the greatest effectiveness in the shortest time. Also, consideration must be given to the substitutability of organizations for each other (i.e., CLRS reverts to FCS function when RPV launch and recovery capabilities is lost).

All these have implications for measureably increased substitutability, therefore unit capability, based on minutes of aerial vehicle coverage per day. These factors have implication for other type organizations as well.

E.2.10 Improvement of the AMORE Methodology as an Aid in the Design and Evaluation of Military Organizations (Hannon, Fineberg, and Helmuth, 1984)

E.2.10.1 Description of Study

Procedures. This research was conducted to examine the AMORE methodology and recommend improvements to it for use as an aid in organizational effectiveness and design. The study closely examined the concepts of the mission essential team (MET), the type of capability that AMORE measures, the type and size of units to which AMORE can be validly applied, and how it can be best used in the force design process.

Results. The study concluded that it was valid to use functional analysis to divide a unit with homogeneous capabilities into METs of approximately equal capability as a yardstick for measuring a unit's ability to reconstitute following the application of degradation. Command and control and internal support functions should be included with the first team of the element since without them the element could not be a viable operational entity. It was concluded that multiple METs should be defined for any unit. The first is the sustained operations MET which would include most if not all of the TOE resources. The second is the intense operations MET which realigns functions and associated resources not required to bring immediate combat power to bear on the enemy and makes available those resources for substituting. In each of the foregoing METs, the unit operational elements retain authorized strength and design capability. To develop reconstitution alternatives, it is also instructional to define METs at various reduced operational strength and capability levels. It was also

concluded that it is necessary to standardize the development of a substitutability solution, recognizing that it will be desirable to conduct excursion analyses with alternative substitutability solutions.

An examination of the AMORE measure and the types of organizational analyses to which AMORE can be applied validly was conducted as the second research objective. It was concluded that AMORE measures neither unit capability nor effectiveness but, rather, measures the increments of capability (METs) which can be reconstituted following degradation. This measure was defined as:

$$R = \frac{\% \text{ of Teams Formed}}{\% \text{ of Remaining Resources}}$$

where R = resilence. Since the AMORE measure is unit resilience, it was suggested that consideration be given to changing the process name from Analysis of Military ORganizational Effectiveness (AMORE) to Analysis of Military Organizational REsilence (AMORE). In addition to measuring unit resilience, AMORE can also provide insights with regard to unit readiness. However, it was concluded that AMORE, by itself, should not be applied to the force design process.

E.2.10.2 Evaluation of Study

Observations stemming from this study indicate a need for a method to state unit mission capabilities quantitatively, in terms of unit performance requirements, standards, and conditions. A standardized procedure for conducting functional analyses is also needed, and should consider duties, tasks, and time sequences in developing unit resoure requirements and MET structures. Finally, a more standard method for defining generally allowable substitutions is needed.